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Founded by HENRY BALDWIN WARD

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Program and Abstracts of the 31st Annual Meeting, American Society of Parasitologists, Storrs, Connectiut, August 26, 27, 28, 29, 1956.

Copies of this Section will be available at Storrs

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THE JOURNAL OF PARASITOLOGY

The Journal of Parasitology, published bi-monthly, is the official organ of the American Society of Parasitologists and as such it publishes the program of the annual scientific meeting, abstracts of the papers presented there, and minutes of the business meetings of the Society.

The Journal of Parasitology is a medium for the publication of the results of research in the field of animal parasitology. Manuscripts dealing with subjects in this field will be considered for publication, and accepted manuscripts will be published in order of receipt. A manuscript is accepted with the understanding that it is to be published exclusively in the Journal unless otherwise arranged in advance.

Articles submitted for publication may be sent to any member of the Editorial Committee or Editorial Board. Responsibility for acceptance of papers is divided in the Editorial Committee for the fields of helminthology, protozoology and entomology. Correspondence concerning the disposition or revision of manuscripts should be addressed to Leon Jacobs, Chairman of the Editorial Committee, Laboratory of Tropical Diseases, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda 14, Maryland.

Manuscripts submitted should be typewritten, double or triple spaced, with wide margins, and with tables, graphs, and illustrations in finished form for transmission to the printer. Title, author, institution, etc., go on a separate sheet. Each table requires a separate sheet. Footnotes are not encouraged. Such material can usually be embodied in the text. If footnotes are used, they should be numbered consecutively and typed on a sheet separate from the text. Authors are urged to emphasize simplicity and clearness in tables. When feasible, sharp, contrasty photographic reproductions of large plates and graphs should be submitted in place of the originals. In preparing plates care should be given to the effective arrangement of figures, to economy of space, and to the amount of reduction required. Figures should be arranged within an area five by eight inches, or multiples thereof. Legends for figures should be typed on a sheet, separate from the text, and containing no illustrations. Greek characters and symbols should be avoided, where possible, since they require hand composition, thus increasing the cost of publication.

The bibliography, double or triple spaced, should contain only those references actually cited in the text, and its style should conform to bibliographies in recent issues of the Journal. The Index Catalogue of Medical and Veterinary Zoology should be used as a guide for abbreviating the journals cited.

Since it is the desire of the Editorial Committee to publish all acceptable manuscripts submitted within the limited space available, authors are urged to present their results briefly, avoiding tables where possible. However, acceptability of a paper will be determined not by its length but by the amount and character of new information included and the form in which it is presented. Long articles, and those with an unusual number of tables and plates, can be published only with the financial cooperation of the author.

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Vol. 42, No. 4, Section 2 (Supplement) August, 1956

PROGRAM AND ABSTRACTS OF THE THIRTY-FIRST ANNUAL MEETING OF THE AMERICAN SOCIETY OF PARASITOLOGISTS

STORRS, CONNECTICUT

August 26, 27, 28, 29, 1956

NOTE: Registration: Sunday through Wednesday. Get Luncheon Tickets at Time of Registration.

PROGRAM[1]

SUNDAY AFTERNOON, AUGUST 26, 2:00 P.M., ROOM 301, STUDENT UNION.

COUNCIL MEETING, OFFICERS AND MEMBERS OF THE SOCIETY'S COUNCIL.

(An evening session, if necessary, will convene at 7:30 P.M. in the same room). (All Past Presidents of the Society are cordially invited to attend all sessions of the Council).

Monday Morning Session, August 27, 9:00 A.M.
Auditorium, Community House.
Allen McIntosh, USDA, PRESIDING

Papers on *NEMATODA*

Read

(Authors are requested to keep within the time limits indicated for each paper)

1. The effect of irradiation on reproduction by the heterogenetic generation of *Strongyloides papillosus* (Wedl, 1856) Ransom, 1911. (15 min.) (Standard lantern). **F. F. Katz,** University of Pennsylvania and Brookhaven National Laboratory.

2. Agar diffusion studies with ascarid antigens. (15 min.). **I. G. Kagan,** University of Pennsylvania.

3. A rapid and accurate nephelometric method for the quantitative determination of helminth eggs in clear suspension. (15 min.) (2×2 lantern). **E. Sadun, D. Allain** and **R. Heimlich,** CDC, Chamblee, Georgia.

4. The distribution and function of glycogen and trehalose in developing eggs of *Ascaris lumbricoides*. (15 min.) (2×2 lantern). **D. Fairbairn** and **R. F. Passey,** McGill University. (Introduced by **T. W. M. Cameron**).

[1] An alphabetical author-index will be found at the end of this section of the program. Extra copies of this supplement will be on sale at the meeting.

5. Effects against dog ascarids of low daily doses of Caricide® in the feed. (15 min.) (Standard lantern). **W. S. Wallace, R. I. Hewitt, L. H. Taylor, Jr.,** and **E. Waletzky,** American Cyanamid Company.

6. Canine ascariasis—a potential zoonosis. (12 min.) (Standard lantern). **F. A. Ehrenford,** Pitman-Moore Company.

7. Data on the incidence of pin-worm infection in Thailand. (10 min.) (Standard lantern). **W. H. Headlee,** Indiana University Medical Center; and **S. Vajrasthira** and **C. Maiphoom,** Thai Ministry of Health.

8. The anthelminthic activity of powdered and liquid Parvex against *Ascaridia galli* and *Heterakis gallinae.* (15 min.) (2×2 lantern). **R. F. Shumard,** North Dakota Agricultural Experiment Station.

9. *Syphacia muris* and its distribution. (10 min.) (Standard lantern). **K. L. Hussey,** Columbia University School of Public Health and Administrative Medicine.

Monday Afternoon Session, August 27, 2:00 P.M.
Auditorium, Community House.

Donald V. Moore, Southwestern Medical School, University of Texas, PRESIDING.

Papers on *NEMATODA* (con.)

Read

(Please abide by the time limits)

10. The stimulation of acquired imunity in dogs by injections of extracts of the esophagus of adult hookworms. (10 min.) (2×2 lantern). **R. E. Thorson,** Alabama Polytechnic Institute.

11. The effects of vitamins and protein hydrolysates on the growth *in vitro* of the free-living stages of *Nippostrongylus muris* under axenic conditions. (15 min.) (Standard lantern). **P. P. Weinstein** and **M. F. Jones,** NIH.

12. Anti-trichostrongyle activity of phenothiazine demonstrated *in vitro.* (10 min.). **J. D. Tiner,** Rutgers University.

13. Observations on age resistance of cattle to parasitic nematodes. (10 min.) (2×2 lantern). **H. Herlich,** USDA, Auburn, Alabama.

14. The relation of semi-weekly pasture rotation to acquisition of gastrointestinal nematodes by sheep. (15 min.) (2×2 and Standard lanterns). **N. D. Levine, R. E. Bradley, D. T. Clark** and **S. Kantor,** University of Illinois.

15. Natural immunity of the white rat to the mouse parasite *Nematospiroides dubius* Baylis, 1926. (8 min.) (Standard lantern). **J. H. Cross Jr.** and **J. A. Scott,** University of Texas Medical Branch at Galveston.

16. Immunity to challenging infections of *Litomosoides carinii* produced by transfer of developing worms. (7 min.) (Standard lantern). **J. A. Scott** and **E. M. MacDonald,** University of Texas Medical Branch at Galveston.

17. Studies on the mosquito transmission of *Dirofilaria tenuis* Chandler, 1942. (8 min.). **W. R. Pistey,** University of Connecticut.

18. Observations on the cytochrome system in *Trichinella spiralis.* (15 min.) (Standard lantern). **E. Goldberg** and **L. O. Nolf,** the State University of Iowa.

19. The use of metabolic antigens in the flocculation test for studying the serological response of rabbits to graded infections with *Trichinella spiralis.* (15 min.) (2×2 lantern). **E. H. Sadun** and **L. Norman,** CDC, Chamblee, Georgia.

20. The antibody response in rabbits to the intestinal and to the extra-intestinal phases of infections with *Trichinella spiralis*. (15 min.) (2×2 lantern). **E. H. Sadun, L. Norman** and **M. M. Brooke,** CDC, Chamblee, Georgia.

Read by Title Only

21. A synthetic basal complement to liver medium for axenic cultivation of the nematode *Caenorhabditis briggsae*. **E. C. Dougherty** and **E. L. Hansen,** Kaiser Foundation Hospital (Oakland) and University of California (Berkeley).

22. Notes on the habitat and tissue-phase of *Ascaridia galli* (Schrank, 1788). **J. F. Moran Jr.** and **J. D. Mizelle,** University of Notre Dame.

23. Methods for securing infective eggs of *Syphacia obvelata* from infected mice. **K. F. Chan,** Columbia University School of Public Health and Administrative Medicine.

24. Further studies on strongyloidiasis in lambs and kids: development of acquired resistance. **J. H. Turner,** USDA, Beltsville, Maryland.

25. Parasites of the Barbary Sheep. **R. W. Allen, W. W. Becklund,** and **R. E. Gilmore,** USDA, State College, New Mexico.

26. Stability of phenothiazine in cane molasses in the control of gastro-intestinal nematodes of cattle. **J. E. Alicata** and **J. H. Koshi,** University of Hawaii.

27. The vector of canine filariasis. **L. Kartman,** USPHS, San Francisco, California.

28. Evaluation of the efficacy of piperazine adipate for the treatment of patients with trichuriasis. **J. C. Swartzwelder, J. H. Miller** and **W. W. Frye,** Louisiana State University School of Medicine; and **R. Lampert,** State Colony and Training School, Pineville, Louisiana.

29. On the unusual hatching posture of the embryo of *Trichuris vulpis in vitro*. **L. M. Yutuc,** University of the Philippines.

Tuesday Morning Sessions, August 28, 9:00 A.M.
Section A. *PROTOZOA.*
Room 311, Beech Hall.
Paul C. Beaver, Tulane University, PRESIDING.

Read

(Please abide by the time limits)

30. *Trypanosoma cruzi* in raccoons from Maryland. (15 min.) (Standard lantern). **B. C. Walton** and **P. M. Bauman,** Walter Reed Army Institute of Research; **L. S. Diamond,** USDA, Beltsville, Maryland; and **C. M. Herman,** Patuxent Research Refuge.

31. Susceptibility of domestic animals to infection with *Trypanosoma cruzi* from the raccoon. (15 min.). **L. S. Diamond** and **R. Rubin,** USDA, Beltsville, Maryland. (Also by demonstration—see paper #83).

32. Antitrypanosomal activity of structural variants of Stylomycin® Puromycin. (15 min.) (Standard lantern). **R. I. Hewitt** and **A. R. Gumble,** American Cyanamid Company. (Introduced by **E. Waletzky**).

33. Studies on the activity of bis-quinaldines against experimental trypanosomiasis. (15 min.). **G. F. Otto, J. C. Moetsch** and **R. U. Schock,** Abbott Laboratories.

34. A method for screening compounds against visceral leishmaniasis in the hamster. (15 min.) (Standard lantern). **E. M. Franchino, J. Grun** and **L. A. Stauber,** Rutgers University.

35. Experimental infections of the genital tract of swine and goats with *Tritrichomonas foetus* and *T.* species from the cecum of swine. (10 min.) (2×2 lantern). **D. M. Hammond** and **W. Leidl,** Gynecological and Ambulatory Veterinary Clinic of the University of Münich, Germany.

36. Observations on vaginal trichomoniasis in monkeys. (10 min.). **E. Eugere, V. Lynch** and **R. K. Thoms,** University of Connecticut. Introduced by **A. C. Walton**).

37. The inhibitory effects of an ion exchange resin on *Trichomonas vaginalis.* (10 min.). **E. Eugere, V. Lynch** and **R. K. Thoms,** University of Connecticut. (Introduced by **A. C. Walton**).

38. Adaptation to carbohydrate substrates and "direct" utilization of maltose by *Trichomonas.* (5 min.). **C. P. Read,** The Johns Hopkins University.

39. Furazolidone as a therapeutic agent in pigeon trichomoniasis. (10 min.). **R. M. Stabler,** Colorado College.

Section B. *TREMATODA* **and** *ACANTHOCEPHALA.*
Room 411, Beech Hall.
Luther O. Nolf, The State University of Iowa, PRESIDING.

Read

(Please abide by the time limits)

49. An ecological study on *Hysteromorpha triloba* at Oakwood Lakes, South Dakota. (10 min.) (2×2 lantern). **E. J. Hugghins,** South Dakota State College.

50. Further studies on *Hysteromorpha triloba,* and some parasites of a white pelican. (10 min.) (2×2 lantern). **E. J. Hugghins,** South Dakota State College. (Also presented by demonstration—see paper #92).

51. On the sexual abnormalities in the male *Schistosoma japonicum.* (15 min.) (2×2 lantern). **S. Y. Li Hsü** and **H. F. Hsü,** The State University of Iowa.

52. Studies on reproduction and growth of *Oncomelania nosophora* and *Oncomelania quadrasi,* intermediate hosts of *Schistosoma japonicum.* (15 min.) (2×2 lantern). **L. Wong** and **E. D. Wagner,** School of Tropical and Preventive Medicine, Loma Linda, California.

53. The ecology of marine dermatitis-producing schistosomes. I. Seasonal variation in infection of mud snails (*Nassa obsoleta*) with larvae of *Austrobilharzia variglandis.* (10 min.) (Standard lantern.) **C. J. Sindermann,** Brandeis University.

54. Transfaunation of *Schistosomatium douthitti.* (12 min.) (Standard lantern). **C. G. Goodchild,** Emory University.

55. Developmental stages in the Digenea. IV. The miracidium of *Neorenifer wardi* (Byrd, 1936) and *Dasymetra conferta* Nicoll, 1911. (12 min.) (2×2 lantern). **M. C. Dunn** and **E. E. Byrd,** University of Georgia.

56. The life cycle of *Plagiorchis parorchis,* n. sp. (15 min.) (Standard lantern and 16 mm. motion picture projector). **R. W. Macy,** Portland State College.

57. Observations on the genus *Atrophececum* Bhalerao, 1940. (10 min.) (2×2 lantern). **H. E. Jordon** and **E. E. Byrd,** University of Georgia.

58. The comparative histochemistry of alkaline glycerophosphatase in the Acanthocephala. (12 min.) (Standard lantern). **W. L. Bullock,** University of New Hampshire.

59. The *in vitro* fermentation of carbohydrates by two species of tapeworms and one species of Acanthocephala. (15 min.) (Standard lantern). **J. S. Laurie,** The Johns Hopkins University.

Read by Title Only

60. On treatment of schistosomiasis japonicum by means of triostam (sodium antimonyl gluconate). **S. Sugiura,** Yamanashi Prefectural Medical Research Institute, Kofu, Japan.

61. Composition of the haptoral armament and copulatory complex of *Urocleidus ferox* Mueller, 1934. **J. E. Berry** and **J. D. Mizelle,** University of Notre Dame.

62. Monogenetic trematodes of the Gulf of Mexico. **R. A. Wood,** Pan American College, Edinburg, Texas.

Tuesday Afternoon Sessions, August 28, 2:00 P.M.
Section A. *PROTOZOA* **(con.).**
Room 311, Beech Hall.
Leslie A. Stauber, Rutgers University, PRESIDING.

Read

(Please abide by the time limits)

40. Studies on the pathology of experimentally produced blackhead in turkeys. (15 min.) (Standard lantern). **T. D. Malewitz,** Michigan State University.

41. Apropos oöcyst measurements. (10 min.) (Standard lantern). **E. R. Becker,** Iowa State College.

42. Morbidity and mortality among chickens infected with large numbers of the intestinal coccidium, *Eimeria acervulina* Tyzzer, 1929. (15 min.) (2×2 lantern). **N. F. Morehouse** and **W. C. McGuire,** Dr. Salsbury's Laboratories.

43. The coccidiostatic activity of soluble furacin against *Eimeria necatrix.* (15 min.) (2×2 lantern). **R. F. Shumard,** North Dakota Agricultural Experiment Station.

44. The effect of allyl acetone in the treatment of experimentally induced cecal coccidiosis in chicks. (10 min.). **W. A. Uricchio,** Mt. Mercy College.

45. The optimum in coccidiostatic activity. (15 min.) (2×2 lantern). **P. D. Harwood, D. I. Stunz** and **R. W. Wolfgang,** Hess and Clark, Inc.

46. The reproductive habits of *Plasmodium cathemerium* in chick and duck embryos. (15 min.) (Standard lantern). **R. B. McGhee,** University of Georgia.

47. The life cycle of *Gregarina hyalellae,* a gregarine parasitic in *Hyalella azteca.* (10 min.) (2×2 lantern). **D. L. Degiusti** and **S. Delidow,** Wayne University.

Read by Title Only

48. Electrophoretic studies of plasma proteins in dogs with amebic dysentery. **E. O'B. Comer** and **C. A. Jones,** Veterans Administration Hospital, New Orleans; and **J. C. Swartzwelder,** Louisiana State University School of Medicine.

Section B. *CESTODA, ARTHROPODA, MOLLUSCA.*
Room 411, Beech Hall.
Francis J. Kruidenier, University of Illinois, PRESIDING.

Read

(Please abide by the time limits)

63. Embryonic development and morphology of onchospheres of the tapeworm *Oochoristica symmetrica.* (15 min.) (2×2 lantern). **R. E. Ogren,** Ursinus College.

64. The effect of different temperatures on the development of *Hymenolepis diminuta* in *Tribolium confusum.* (10 min.) (Standard lantern). **M. Voge** and **J. A. Turner,** University of California School of Medicine (Los Angeles).

64a. *In vitro* study of *Hymenolepis nana* rabbit antiserum against eggs, cysticercoids, and adult stages of that parasite. (15 min.) (Standard lantern). **D. Heyneman** and **J. F. Welsh,** University of California (Los Angeles).

65. Carbohydrate quantity and quality: Its significance in the biology of tapeworms. (10 min.) (Standard lantern). **C. P. Read** and **A. H. Rothman,** The Johns Hopkins University.

66. Survival of *Chorioptes bovis* (Gerlach) on epidermic debris and hair from various mammals under *in vitro* conditions. (10 min.) (2×2 lantern). **G. K. Sweatman,** Animal Pathology Division, Canada Department of Agriculture.

67. Studies on the feeding habits of three species of laelaptid mites (15 min.) (2×2 lantern). **G. W. Wharton,** University of Maryland; and **H. F. Cross,** Northeastern Louisiana State College.

68. Observations on the nasal mite genus *Sternostoma* Berlese and Trouessart. (10 min.). **D. P. Furman,** University of California (Berkeley).

69. Pentastomids from African reptiles and mammals and from reptiles of Florida Island, British Solomon Islands. (10 min.) (2×2 lantern). **J. T. Self,** University of Oklahoma; and **R. E. Kuntz,** Naval Medical School, Bethesda, Maryland.

70. Surface wintering of aquatic snails in central Washington. (10 min.) (2×2 lantern). **C. W. McNeil** and **W. M. Walter,** State College of Washington.

71. Studies on the biological control of schistosome-bearing snails: A preliminary report on pathogenic microorganisms found in *Australorbis glabratus.* (10 min.) (Standard lantern). **C-t. Pan,** Harvard School of Public Health. (Introduced by **D. L. Augustine**). (Also presented by demonstration—see paper #102).

72. The role of documentation in parasitological research. (10 min.). **M. A. Doss,** USDA, Beltsville, Maryland. (Also presented by demonstration—see paper #103.

Read by Title Only

73. Acquired immunity in lambs infected with *Taenia hydatigena* Pallas, 1766. **G. K. Sweatman,** Animal Pathology Division, Canada Department of Agriculture.

74. The distribution of succinic dehydrogenase activity in *Hymenolepis diminuta* and *Raillietina cesticillus.* **R. M. Hedrick,** The Rice Institute.

75. New records of the occurrence of the hydatid tapeworm, *Echinococcus*

granulosus, in central and south Mississippi. **J. W. Ward** and **R. C. Bradshaw,** University of Mississippi Medical Center and Jackson Packing Company.

76. Polysaccharide metabolism in cestodes and acanthocephala. **C. P. Read** and **A. H. Rothman,** The Johns Hopkins University.

77. The active absorption of methionine by cestodes. **J. W. Daugherty,** The Rice Institute.

78. Effect of lindane on the hatchability of the eggs of *Chorioptes bovis* (Gerlach). **G. K. Sweatman,** Animal Pathology Division, Canada Department of Agriculture.

79. Blood parasites in reptiles. **R. W. Hull,** Northwestern University; and **J. H. Camin,** Chicago Academy of Sciences.

Wednesday Morning Sessions, August 29. Rooms 101–102, Student Union.

SYMPOSIUM, 9:00–11:00 A.M. "THE PROBLEM OF INTRA-SPECIFIC VARIATION IN PARASITIC ANIMALS." (Under joint auspices of the American Microscopical Society, the Society of Systematic Zoology and the American Society of Parasitologists—arranged by **J. S. Rankin Jr.**).

J. A. Slater, PRESIDING.

a. *PROTOZOA*—**R. D. Manwell,** Syracuse University.

b. *FLATWORMS*—**H. W. Stunkard,** American Museum of Natural History.

c. *NEMATODES*—**M. B. Chitwood,** USDA, Beltsville, Maryland.

d. *MITES*—**G. W. Wharton,** University of Maryland.

PRESIDENTIAL ADDRESS, AMERICAN SOCIETY OF PARASITOLOGISTS. 11:15 A.M.

Aurel O. Foster, Vice-President, ASP, PRESIDING.

80. "Stepping Stones in the History of A.S.P." **Eloise B. Cram,** National Institutes of Health, Bethesda, Maryland. (Introduced by **Leon Jacobs,** NIH.).

Wednesday Noon, August 29, 12:30 P.M. The Cage.
Annual Luncheon and Business Meeting of the Society.
E. B. Cram, PRESIDING.
(Get tickets at time of registration)

Wednesday Afternoon Session, August 29, 2:30 P.M.
Rooms 227, 233, 234, 311, 330, 340, Beech Hall.
L. R. Penner, IN CHARGE. (Laboratories will be open all Wednesday morning for setting up demonstrations).

All Papers by Demonstration and Exhibit

81. Some stages in the life cycle of *Nematospiroides dubius* Baylis, 1926. **J. H. Cross Jr.** and **J. A. Scott,** University of Texas Medical Branch at Galveston.

82. An electron microscope study of *Plasmodium lophurae.* **M. A. Rudzinska** and **W. Trager,** Rockefeller Institute for Medical Research.

83. Susceptibility of domestic animals to infection with *Trypanosoma cruzi*

from the raccoon. **L. S. Diamond** and **R. Rubin,** USDA, Beltsville, Maryland. (Also read—see paper #31).

84. A new digenetic trematode from the muskellunge, *Esox m. masquinongy.* **J. H. Fischthal,** Harpur College.

85. Studies on the genus *Plagitura* Holl, 1928. **F. J. Etges** and **M. E. Patzer,** University of Cincinnati.

86. Hepatitis due to *Amphimerus pseudofelineus* in a cat. **N. D. Levine, P. D. Beamer** and **D. Maksic,** University of Illinois.

87. Concerning the early developmental stages of *Ornithobilharzia canaliculata* (Rudolphi, 1819). **L. R. Penner** and **A. Wagner,** University of Connecticut.

88. Studies on the biology of marine acquired avian schistosomiasis. **L. R. Penner,** University of Connecticut. (A 16-mm color film will be shown as a part of this demonstration).

89. The life-history of *Macroderoides spiniferus* Pearse, 1924, a trematode of the Florida Spotted Gar, *Lepisosteus platyrhincus.* **W. H. Leigh,** University of Miami.

90. Observations on life-histories of members of the genus *Ascocotyle* Looss. **W. H. Leigh,** University of Miami.

91. Development of *Cotylurus flabelliformis* tetracotyles in the second intermediate host. **M. J. Ulmer,** Iowa State College.

92. Further studies on *Hysteromorpha triloba,* and some parasites of a white pelican. **E. J. Hugghins,** South Dakota State College. (Also read—see paper #50).

93. The pathology and pathogenesis of fatal infections due to an acanthocephalid parasite of marmoset monkeys. **L. J. Thomas,** University of Illinois; and **M. J. Takos,** Gorgas Hospital, Ancon, Canal Zone.

94. Some parasites of the English Sparrow in Maryland. **G. I. Wilson,** USDA, Beltsville, Maryland.

95. A comparison of the genera *Gyrocoelia* Fuhrmann, 1899 and *Infula* Burt, 1939. **W. H. Coil,** Ohio State University.

96. Studies on rodent echinococcosis. **L. J. Thomas** and **B. B. Babero,** University of Illinois and the Arctic Aeromedical Laboratory.

97. Morphological variations in the embryonic hooks of tapeworms. **J. C. Hwang** and **K. C. Kates,** USDA, Beltsville, Maryland.

98. The early embryology of the nematotaeniid cestode, *Baerietta diana* (Helfer, 1948) comb. nov. **L. T. Douglas,** Emory and Henry College.

99. Early stages of the larvae (*Cysticercus bovis*) of *Taenia saginata.* **A. McIntosh,** USDA, Beltsville, Maryland.

100. A survey of cestodes in mammals from Grand Canyon National Park. **F. J. Kruidenier** and **V. Gallicchio,** University of Illinois.

101. Nostril entry as the mode of infection by the first stage larvae of a rodent *Cuterebra.* **L. R. Penner** and **F. P. Pocius,** University of Connecticut.

102. Studies on the biological control of schistosome-bearing snails: A preliminary report on pathogenic microorganisms found in *Australorbis glabratus.* **C-t. Pan,** Harvard School of Public Health. (Also read—see paper #71).

103. The role of documentation in parasitological research. **M. A. Doss,** USDA, Beltsville, Maryland. (Also read—see paper #72).

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IN MEMORIAM

HARVEY F. CUNOV (Member since 1948)
H. RANDOLPH HALSEY (Member since 1944)

ABSTRACTS

1. **The Effect of Irradiation on Reproduction by the Heterogenetic Generation of *Strongyloides papillosus* (Wedl, 1856) Ransom, 1911.** FRANK F. KATZ, The University of Pennsylvania and Brookhaven National Laboratory.

Attempts to induce successive free-living generations in *Strongyloides papillosus,* in which this phenomenon apparently does not normally occur, by irradiation of the sperm and/or ova were not successful. Theoretically, such gynogenetic and/or androgenetic induction should be possible in view of the triploidy which has been observed in this worm (Chang and Graham, personal communication). Although x-ray was used, the major work involved cobalt-60 gamma irradiation. The nematodes were cultured *in vitro* under non-sterile conditions, the best cultures being obtained in open depression slides with a nutrient agar-fecal extract medium diluted one-half with distilled water and adjusted to pH 7.

Extensive data accumulated concerning immediate irradiation effects. Results have been analyzed on the basis of the number of larvae per bisexual pair or gravid female, hatching, survival, and lethal and dominant lethal effects. Fewer offspring were produced in bisexual cultures containing irradiated males of the fourth and fifth stage than in bisexual cultures of irradiated third or fourth stage females. With increased doses of irradiation there was a decrease in the percentage of eggs hatching and survival of the larvae. Cleavage rate and embryogenesis were delayed by irradiation. Spermatozoa were still active in uteri at 5 hours after 20 kr exposure. The production of lethal and dominant lethal effects increased with increased dosage so that at 20 kr in gravid females and 40 kr in bisexuals 100 per cent killing effects occurred.

(Research carried out at Brookhaven National Laboratory under the auspices of the U. S. Atomic Energy Commission.)

2. **Agar Diffusion Studies With Ascarid Antigens,** IRVING G. KAGAN, University of Pennsylvania.

Utilizing a double diffusion agar technique, studies on the nature and specificity of ascarid antigens are in progress. Antisera against lyophylized pig ascaris (*A. lumbricoides* var. *suum*), human ascaris, (*A. lumbricoides*), dog ascaris (*Toxocara canis*) and cat ascaris (*T. felis*) were prepared in rabbits by subcutaneous injections in Freund's adjuvant. Additional antigens were prepared from cuticle, muscle, worm enteric fluid, non-embryonated eggs, embryonated eggs and polysaccharide fractions of pig ascaris. With full strength pig ascaris antiserum homologous whole worm antigen showed 9 distinct antigen-antibody glands, enteric fluid 9, polysaccharide 7, non-embryonated egg 6, muscle 6, cuticle 6, embryonated egg 2, human ascaris 7, dog ascaris 5, and cat ascaris 6 bands in the agar. At a 1:8 dilution of pig ascaris antiserum with normal rabbit serum the number of bands fell from 9 to 4. This indicates that some of the antibodies are present in high concentrations.

Absorption studies showed that some antigens present in the fractions of pig ascaris are common to one another. Polysaccharide antibodies were the most difficult components to absorb with heterologous antigens. Enteric fluid, non-embryonated egg and muscle were able to absorb all but one or two polysaccharide antibodies in homologous antiserum. Experiments to determine the specificity of the four ascarid species are in progress.

3. **A Rapid and Accurate Nephelometric Method for the Quantitative Determination of Helminth Eggs in Clear Suspensions.** ELVIO H. SADUN, DOROTHY ALLAIN, ROGER HEIMLICH, Communicable Disease Center, Chamblee, Ga.

In the attempt to apply photometric methods to the counting of helminth eggs in clear suspensions, different concentrations of *Ascaris* eggs were prepared in 4 flasks containing 33 per cent glycerol in distilled water. From each flask, 6 ml of the egg suspension were transferred to 10 cuvettes and 1 ml of the egg suspension was transferred to 10 test tubes. Twenty nephelometric readings were performed on each of the cuvettes and 10 egg counts were performed for each test tube, for a total of 800 nephelometric readings and 400 egg counts. The results indicate a linear relationship between the concentration factors and the nephelometric readings. It was determined that each nephelometric unit corresponded approximately to 60 eggs per milliliter.

Statistical analysis of the data revealed that in both methods the variability was directly proportional to the magnitude of egg concentration. The direct egg counting technique gave substantially greater variations than the nephelometric readings. The average time employed for a nephelometric determination was approximately 30 seconds whereas that for the egg

count varied from 5 minutes in the tubes with the lowest egg concentration to 15 minutes in those with the highest egg concentration.

On the basis of these results, it is concluded that nephelometric estimates for the quantitative determination of helminth eggs in clear suspensions are more rapid and more accurate than an equivalent number of egg counts.

4. **The Distribution and Function of Glycogen and Trehalose in Developing Eggs of *Ascaris lumbricoides*.** DONALD FAIRBAIRN AND RICHARD F. PASSEY, McGill University.

The fertilized *Ascaris* egg contains large amounts of carbohydrate which is stable to strong alkali, and yields glucose after acid hydrolysis. About one-half of this carbohydrate is glycogen. The remainder was isolated and identified as the non-reducing disaccharide, trehalose. During development to the vermiform stage, when the rate of oxygen consumption is increasing to a maximum, glycogen and trehalose decrease 50%. Subsequently, while the embryo is molting and maturing to the infective stage, and oxygen consumption is decreasing, these carbohydrates are resynthesized to their initial levels. Thereafter, the embryo uses very little carbohydrate for energy metabolism. Energy and carbon required for the resynthesis of carbohydrates are supplied by the oxidation of neutral fats, which occur in large amounts in the egg.

In the infective egg, glycogen occurs exclusively in the embryo (8.9 gm per 100 ml) whereas trehalose is found mainly in the perivitelline fluid (13.9 gm per 100 ml). The embryonic glycogen at this stage may serve as a readily available energy source for the hatched larvae. Trehalose, on the other hand, will be lost during the hatching of the egg, and is therefore an improbable energy source. Its function, if any, may be related to the maintenance of a high osmotic pressure in the infective and hatching egg.

5. **Effects Against Dog Ascarids of Low Daily Doses of Caricide® in the Feed.** W. S. WALLACE, R. I. HEWITT, L. H. TAYLOR, JR., AND E. WALETZKY, American Cyanamid Company.

Previous published data have demonstrated that Caricide® 1-diethylcarbamyl-4-methylpiperazine is highly effective against dog and cat ascarids (Hewitt *et al*, 1948 J. Parasitol. **34:** 237–239; Kanegis, 1948. J. Am. Vet. Med. Ass. **113:** 579). Using the hydrochloride salt, single oral doses of 50 mg/kg, and two doses of 25 mg/kg removed nearly 100 per cent of the worms. Recently, it has been found that daily doses as low as 2.0 mg/kg (expressed as the base) of Caricide added to canned dog rations eliminate the majority of *Toxocara canis* from naturally infected puppies within 3 to 5 days. Preliminary results indicate that daily doses of 5.0 mg/kg of the base equivalent in the feed interferes with the development of experimental infections with *T. canis* and *Toxascaris leonina*. Eosinophilia developed, but no worms were found during the experiment or at necropsy. Puppies treated daily with 2.0 mg/kg of the base equivalent for periods up to 15 weeks developed no overt toxic symptoms, and weight gains were similar to those of untreated controls.

The results with these low doses of Caricide are superior to what has been obtained with 25 times the amount (50 mg/kg per day) of piperazine hexahydrate in the feed, or 12.5 times as much piperazine base. This indicates that the antiascarid effect of Caricide is not a direct function of the piperazine content, which represents less than one-half of the molecule. Other variations in the anthelmintic spectrum of Caricide and simple piperazine salts which strengthen this point will be discussed.

6. **Canine Ascariasis—A Potential Zoonosis.** F. A. EHRENFORD, Research Dept., Pitman-Moore Co., Indianapolis.

Recent investigations (summarized by Beaver 1954, Vet. Med. **49:** 199–202, 205) involve *Toxocara canis* as an etiological agent in human visceral larva migrans. Since this correlation is of interest as a zoonosis, information on the reservoir host would be desirable.

By means of a qualitative fecal diagnosis for a period of 26 months on 1,465 dogs an incidence of 21.0% was found for *T. canis*, 4.1% for *Toxascaris leonina*, and 0.003% for *T. cati*.

Separating the data by sex of host in 1,324 dogs, it was found that males were 32.8% infected with *T. canis*, while females were only 9.4% infected. *T. leonina* was found in 3.1% (av.) of both sexes.

Further analysis according to age (3–36 months) and sex of host in 1,294 dogs showed that: Puppies of both sexes had a high incidence of infection with *T. canis;* male dogs had a significantly higher incidence of infection than did females, as well as evidence of no im-

munity up to 36 months of age; female dogs exhibited a marked and increasing immunity from 6–36 months of age.

Seasonal variation in incidence of *T. canis* was found to be most pronounced in males, which had the highest incidence during winter months. Females had a lower and more uniform incidence throughout the seasons.

This study shows that in a sample from the Ohio River Drainage *T. canis* is the predominant ascarid in dogs and that male dogs at all ages are a likely source of *T. canis*. This study gives strong support to Beaver's contention that *T. canis* is the principal etiological agent in human visceral larva migrans.

7. **Data on the Incidence of Pinworm Infection in Thailand.** WM. HUGH HEADLEE, Indiana University Medical Center; SUVAJRA VAJRASTHIRA, AND CHETANA MAIPHOOM, Department of Health, Thai Ministry of Public Health.

The incidence of the pinworm, *Enterobius vermicularis*, as reported by Barnes and O'Brien (1924), on the basis of brine flotation stool examinations, was 0.9%. Data obtained in 1953 and 1954 by the examination of stools from 79,102 individuals of all ages living in both urban and rural communities in 19 of the 70 provinces of Thailand, using the plain fecal smear technique, indicated an incidence of 0.6%, with a range of 0 to 2.4% in various groups.

In 1955, children attending a private school in Bangkok were examined, using the cellulose adhesive tape method. Examinations were made on each individual for 6 successive days, unless found to be positive for the pinworm before the sixth day. Of 270 children examined, 198, or 73.3%, were positive for the pinworm. The ages of the children ranged from 4 to 14 years, 228 being in the age-group 5–9 years. There were 131 males and 139 females. The 36 persons who were 4 years of age, and the 6 individuals who were in the age-group 10–14 years were all infected.

Other infections found by the cellulose adhesive tape method in this group of children, and their percentage incidences, were: *Taenia* spp., 0.4; *Trichiurus trichiura*, 0.4; and *Ascaris lumbricoides*, 16.7.

8. **The Anthelmintic Activity of Powdered and Liquid Parvex Against** *Ascaridia galli* **and** *Heterakis gallinae*. R. F. SHUMARD, North Dakota Agricultural Experiment Station.

Studies on acute toxicity with liquid Parvex (Piperazine-1-carbodithioic betaine) showed that the drug was not toxic in single doses of 640 mg/kg of body weight or less in chickens. Toxicity was probably due to the high alkalinity of the product. Single doses as high as 11,648 mg/kg of the powdered product were not acutely toxic. Twenty-one-day toxicity trials indicated that the liquid form of Parvex, given in the drinking water was not toxic in doses as high as 160 mg/kg per day. The powdered product, administered in the feed over a 21-day period was non-toxic at 160 mg/kg body weight.

Critical studies with liquid and powdered Parvex on experimentally infected chickens indicate that both forms of the drug are effective against *Ascaridia galli* at dosages as low as 75 mg/kg but are not efficient against *Heterakis gallinae* in dosages as high as 225 mg/kg body weight.

9. *Syphacia muris* **and its Distribution.** KATHLEEN L. HUSSEY, School of Public Health and Administrative Medicine, Columbia University.

The eggs of the *Syphacia* from the cecum of the albino mouse are different both in size and shape from those of the *Syphacia* obtained from albino rats from one source (Carworth Farms).

Yorke and Maplestone's figures of the egg and adult male of *S. obvelata* appear to be the *Syphacia* which we found in the rat but not in the mouse, while Chitwood's figure of the egg of *S. obvelata* corresponds to those we found in the mouse.

According to Tiner's key to the species of the genus *Syphacia*, both belong to the 3 "mamelon" group, although differing in size, position of "mamelons", length of male tail, position of excretory pore, size of egg.

We identify the mouse form as *S. obvelata* (Seurat, 1916) while the rat form appears to be *S. muris* (Yamaguti, 1935). Tiner (personal communication) had identified the *Syphacia* from the cecum of Carworth Farms rats as *S. muris*.

Experimental infection of the mouse with *S. muris* from the rat has been successful.

As these worms deposit characteristic eggs in the perianal region, infection may be detected by anal swabs, as for enterobiasis.

Since *S. muris* had not been reported from rats in this country we studied its incidence and distribution. Through the kindness of colleagues, who sent Scotch tape anal swabs and/or preserved worms from their mouse and rat colonies, we have found *S. muris* to be the common *Syphacia* of rats and *S. obvelata* the common *Syphacia* of mice. In this survey 5 cases of apparent cross infection have appeared, indicating that mice may occasionally serve as hosts for *S. muris* and rats for *S. obvelata.*

10. **The Stimulation of Acquired Immunity in Dogs by Injections of Extracts of the Esophagus of Adult Hookworms.** RALPH E. THORSON, Alabama Polytechnic Institute.

Since it has been shown that serum from a dog refractory to further infection with *Ancylostoma caninum* inhibits the proteolytic activity in extracts of the esophagus of adults of this worm (Thorson, 1956), it was desirable to determine if injections of these esophageal extracts into dogs would cause the formation of antibodies which by inhibition of the proteolytic activity in the esophagus of worms would cause some interference with the development of a challenge infection. Four puppies of a litter received a total of 3.6 ml of esophagus extract. One ml of this extract represented the extraction of approximately 200 esophagi in physiological saline. There were 80 micrograms of protein nitrogen in each ml and 1 microgram of this nitrogen could produce 20 microliters of 0.02 N amino acids in a 2-hour reaction period using a microliter modification of Sorensen's formol titration with casein as the substrate. Three puppies of the same litter received no injections. All the dogs were injected subcutaneously with 250 infective larvae of *A. caninum* several days after the injections were completed. The adult hookworms of this challenge infection were fewer in number and smaller in the dogs which had received injections of esophageal extracts than those in dogs which were not injected, indicating that antibodies were formed to the substances in the esophagus extracts and these antibodies did inhibit the development of a challenge infection. (This investigation was supported in part by a research grant E-872 from the National Microbiological Institute of the National Institutes of Health, Public Health Service.)

11. **The Effects of Vitamins and Protein Hydrolysates on the Growth *in vitro* of the Free-living Stages of *Nippostrongylus muris* under Axenic Conditions.** PAUL P. WEINSTEIN AND MYRNA F. JONES, National Institutes of Health, Bethesda, Maryland.

Fifty percent chick embryo extract dialyzed against Tyrode solution would not support the growth of *N. muris* larvae to the filariform stage, as contrasted to high yields of filariform larvae obtained in non-dialyzed extract. Supplementing dialyzed extract with a mixture composed of acid-hydrolyzed casein ("vitamin-free") and water-soluble vitamins restored the ability of the extract to support the growth of larvae to the filariform stage, although at a reduced level when compared to the non-dialyzed control. When tested separately, the important component of the mixture was found to be the water-soluble vitamins, and not the amino acids.

Diluting 50% embryo extract stepwise in Tyrode solution resulted in a sharp decrease in yield of filariform larvae. For example, only 1.7% of the larvae developed in 12.5% extract. Diluting extract in Tyrode solution to which was added a mixture composed of acid-hydrolyzed casein and water-soluble vitamins maintained the growth-promoting activity even when the extract was present in relatively low concentrations, so that in 12.5% extract, 63% of the larvae developed to the filariform stage. The evidence indicates that as with dialyzed extract, the vitamins lost by dilution are one of the important limiting factors for growth, under the test conditions used.

12. **Anti-trichostrongyle Activity of Phenothiazine Demonstrated *in vitro*.** J. D. TINER, Institute of Microbiology, Rutgers University, The State University of New Jersey, New Brunswick, N. J.

Anthelmintic tests using *in vitro* systems have not consistently detected phenothiazine at dilutions comparable to therapeutic or prophylactic levels. Therefore, the following experiment was performed.

Eggs of the respective gastric and intestinal trichostrongylid nematodes, *Obeliscoides cuniculi* and *Trichostrongylus calcaratus,* were harvested from rabbit feces. They were collected by flotation, disinfected with a mixture of sodium hypochlorite and formalin, and repeatedly rinsed by centrifugations in sterile distilled water. These eggs were then aseptically pipetted into sterile watch glasses (BPI dishes), some of which contained sufficient once-recrystallized phenothiazine (provided by Merck & Co., Inc.) to produce a concentration of one microgram per ml of water. Incubation proceeded under moist chamber conditions at 20° C. After 24 hours, eggs in the control dishes were hatching, whereas treated dishes con-

tained only malformed embryos. Phenothiazine stopped gastrulation and organogenesis, although cell divisions appeared to continue for a time after treatment. The insecticide rotenone was also tested. It permitted development of recognizable first-stage larvae, but these did not hatch.

13. **Observations on Age Resistance of Cattle to Parasitic Nematodes.** HARRY HERLICH, Regional Animal Disease Research Laboratory, Agricultural Research Service, U. S. D. A., Auburn, Alabama.

Three 18-month-old steers and three 5-month-old steer calves, all grade Jerseys raised free of helminths, were put out to graze on a 2-acre pasture of green oats in February, 1956. One-fifth of this pasture had been fenced off and contaminated by spreading manure containing eggs of *Trichostrongylus axei, T. colubriformis* and *Ostertagia ostertagi* immediately prior to the test. All animals grazed together and they spent a total of 4 weeks over 3 different intervals on the contaminated portion of the pasture. The bovines were killed after grazing for 51 days. Prior to slaughter, fecal egg counts never exceeded 200 eggs per gram.

At slaughter the older steers had an average of 11,887 nematodes, whereas the calves had an average of 31,087. The difference in average worm burden was not statistically significant; however, on the basis of age and weight, the older steers should have consumed approximately 3 times more forage daily, and presumably would have ingested many more infective larvae than the young animals. Despite this possibility, the younger animals actually harbored 2.5 times more worms than the older animals.

This test indicates that the older steers apparently had acquired some resistance with age to the nematodes.

14. **The Relation of Semi-Weekly Pasture Rotation to Acquisition of Gastrointestinal Nematodes by Sheep.** NORMAN D. LEVINE, RICHARD E. BRADLEY, DAVID T. CLARK* AND SIDNEY KANTOR**, University of Illinois. (* Present address, College of Veterinary Medicine, Michigan State Univ. ** Now Cooperative Agent, Animal Disease and Parasite Research Branch, USDA.)

During the 1955 grazing season a pasture rotation experiment was carried out in which 9 ewes and 9 lambs were moved twice a week thru a series of 12 fescue-alfalfa pastures. A control group of 9 ewes and 9 lambs was maintained on an unrotated pasture.

On May 4, 1955, when the animals were placed on pasture, the mean fecal strongyle egg counts of both the rotated and control ewes were 200 e.p.g., and the lambs were negative. The mean egg count of the rotated ewes reached a peak of 2294 e.p.g. on August 24, and that of the control ewes reached a peak of 650 e.p.g. on the same date. Eggs were first seen in the feces of the rotated lambs on July 18; the mean egg count in these animals reached a peak of 27,961 e.p.g. on August 24. Eggs were first seen in the feces of the control lambs on July 11; the mean egg count in these animals reached a peak of 8406 e.p.g. on August 24. Thereafter the egg counts of both rotated and control lambs decreased rapidly and spontaneously. On Oct. 20 the mean egg count of the rotated ewes was 613 e.p.g., that of the control ewes was 350 e.p.g., that of the rotated lambs was 2086 e.p.g., and that of the control lambs was 2950 e.p.g.

On May 4, when the animals were placed on pasture, the mean weight of the rotated lambs was 25.5 pounds, and that of the control lambs was 26.4 pounds. The control lambs gained weight more rapidly than the rotated ones. On July 18 the mean weight of the rotated lambs was 64.0 pounds, and that of the controls was 73.1 pounds. The rotated lambs then started to lose weight, while the controls continued to gain slowly. On August 8 the mean weight of the rotated lambs was 55.3 pounds, and that of the controls was 75.9 pounds. Two of the rotated lambs died of parasitism before the next weighing. On Oct. 4 the mean weight of the remaining rotated lambs was 69.2 pounds, while that of the controls was 76.6 pounds.

15. **Natural Immunity of the White Rat to the Mouse Parasite *Nematospiroides dubius* Baylis, 1926 (Nematoda: Heligmosomidae).** JOHN H. CROSS, JR. AND J. ALLEN SCOTT, University of Texas Medical Branch at Galveston.

A strain of *Nematospiroides dubius* originally obtained from *Peromyscus* has been supplied to us through the courtesy of F. A. Ehrenford. We have confirmed his results indicating that the laboratory mouse serves as a normal host. Worms encyst in the intestinal wall of the mouse soon after infection. Six to 8 days after infection they re-enter the lumen as young adults and produce eggs on about the ninth day.

Our experiments show that in the white rat infections do not reach the egg-laying stage. On the tenth day the worms were still encysted in the intestinal wall and showed evidence of disintegration before reaching maturity.

In rats given injections of cortisone daily from the day of infection the worms matured and laid eggs only a few days later than in the mouse. Apparently the mechanism of natural immunity in the rat is related to some type of host response located in the intestinal wall.

(This work was supported by National Science Foundation Grant 1213.)

16. **Immunity to Challenging Infections of *Litomosoides carinii* Produced by Transfer of Developing Worms.** J. ALLEN SCOTT AND ETTA MAE MACDONALD, University of Texas Medical Branch at Galveston.

We have reported previously on immunity to superimposed challenging infections of *Litomosoides carinii* produced by surgical transfer of developing worms into the peritoneal cavity of cotton rats. Single transfers of 26-day old worms in numbers greater than 50 were shown to produce immunity. In the present experiment cotton rats received 3 weekly transfers totalling 187–226 worms which had developed 7 days in donor cotton rats. Retarded growth of challenging infections made a month later showed the presence of immunity. When the experiment was repeated with transferred worms totalling 132–154, no immunizing effect could be detected. We attribute these discordant results to the fact that at this age and with the doses used we are probably working near the threshold level for the induction of immunity.

(This work was supported by National Institutes of Health Grant E 64.)

17. **Studies on the Mosquito Transmission of *Dirofilaria tenuis* Chandler, 1942.** WARREN R. PISTEY, The University of Connecticut, Storrs.

An attempt to determine the vectors of *Dirofilaria tenuis* Chandler, 1942, found in the subcutaneous tissue of raccoons trapped on Longboat Key, in Sarasota County, Florida, has indicated that the microfilariae develop readily in *Aedes taeniorhynchus*. The infective larvae are found in the proboscis 10–12 days after a blood meal on infected raccoons. Preliminary experiments with *Anopheles quadrimaculatus* suggest that this species may also serve as a possible vector. Development of the larvae in *A. taeniorhynchus* occurs in the malpighian tubules with evidence indicating that the larvae penetrate the wall of the ventriculus to gain access to the haemocoel from which they enter the labial gutter.

Mortality studies with *A. taeniorhynchus* suggest a nocturnal periodicity, as mosquitoes fed on infected blood meals at midnight suffer a higher mortality than those fed during the day. The increase in microfilariae is evident in smears taken at night.

The examination of 1125 mosquitoes caught wild on Longboat Key, Florida, during the summers of 1954–55, showed 1.6 per cent of the *A. taeniorhynchus* with various developmental stages of microfilariae resembling *D. tenuis* in the malphigian tubules.

An attempt to infecte young raccoons by subjecting them to the bites of infected mosquitoes has been inconclusive.

18. **Observations on the Cytochrome System in *Trichinella spiralis*.** ERWIN GOLDBERG* AND L. O. NOLF, The State University of Iowa. (* Public Health Service Research Fellow of the National Institute of Allergy and Infectious Diseases.)

Spectroscopic observations of packed suspensions of *Trichinella spiralis* larvae, cooled with liquid nitrogen, reveal the approximate absorption bands of the cytochromes c, b and $a + a_3$. Cell-free distilled-water homogenates of the larvae possess cytochrome oxidase activity, succinate-cytochrome c reductase and dihydrocozymase-cytochrome c reductase activities as determined by spectrophotometric assays. Cytochrome oxidase and the cytochrome c-reductases are also present in homogenates of the adult worms, although the enzymes are apparently less active than in the larvae.

The cytochrome oxidase activity is inhibited by cyanide in low concentrations (10^{-5} M) and the succinate-cytochrome c reductase activity is inhibited by sodium malonate. Studies are presently being conducted on the effect of carbon monoxide on the respiration of larval homogenates.

The results indicate the presence of the complete classical-type cytochrome system to mediate electron transport in *Trichinella spiralis*.

19. **The Use of Metabolic Antigens in the Flocculation Test for Studying the Serological Response of Rabbits to Graded Infections with** *Trichinella spiralis.* ELVIO H. SADUN AND LOIS NORMAN, Communicable Disease Center, Chamblee, Ga.

Several groups of rabbits were infected with doses varying from 500 to 400,000 larvae of *Trichinella spiralis.* The 50% lethal dose, under the experimental conditions, was 88,600. The size of inoculum had an inverse relationship to the average time of survival.

Thirty-nine infected rabbitts were bled weekly and the sera were tested by the flocculation reaction using metabolic and purified somatic larval antigens. With both antigens, the time interval from inoculation to the first positive serology was inversely related to the size of the infective dose and varied from 1 to 7 weeks. The geometric means of the titer (GMT) increased rapidly up to 8 to 10 weeks following inoculation after which time it began to decrease gradually. The peak GMT was directly related to the size of the inoculation and was always higher with the metabolic antigen. No false positives were observed in any of the negative control sera. Although a striking similarity of results with the 2 antigens was observed, the metabolic antigen seemed to confer a somewhat greater sensitivity to the flocculation test. Out of 939 paired serum specimens, 122 were negative and 751 positive with both antigens. Of the 68 sera giving different reactions, 48 were positive with the metabolic antigen alone. Quantitatively, 544 sera had higher titers and 77 had lower titers with the metabolic antigen.

20. **The Antibody Response in Rabbits to the Intestinal and to the Extra-Intestinal Phases of Infections with** *Trichinella spiralis.* ELVIO H. SADUN, LOIS NORMAN, AND M. M. BROOKE, Communicable Disease Center, Chamblee, Ga.

A study was set up to determine whether the intestinal phase and the muscular phase of trichina infection, independently of each other, are sufficient to elicit a serological response detectable by flocculation and complement-fixation tests. The intestinal phase of the infection alone, produced by worms sterilized by irradiation, stimulated low antilarval antibody titers for short periods of time provided that more than 1 exposure took place.

The musclar phase alone, produced by extra-intestinal larval inoculation, stimulated the production of antibodies in relatively high titers.

All of the trichinae exposed to 20,000 roentgens were unable to produce offspring. On the other hand, a few apparently normal second generation larvae were obtained from trichinae exposed to 13,000 roentgens. Six of the intravenously inoculated rabbits were found to harbor living larvae within the muscle after several weeks. In 1 animal, 27 adults had become sexually differentiated in the muscle. No living larvae were recovered by digestion from the rabbits which had been inoculated intramuscularly. Larvae were found in the subcutaneous tissues only in those rabbits which received larvae subcutaneously.

21. **A Synthetic Basal Complement to Liver Medium for Axenic Cultivation of the Nematode** *Caenorhabditis briggsae.* ELLSWORTH C. DOUGHERTY AND EDER LINSDAY HANSEN, Kaiser Foundation Hospital (Oakland) and University of California (Berkeley).

Heretofore axenic cultivation of *C. briggsae* has been accomplished only in media containing preparations of liver or other tissues, or of plasma, at high levels (Dougherty, 1953, J. Parasitol. **39:** 371–380). It is now possible to report success in largely replacing these materials with known ingredients. We are calling such defined mixtures "Gordon media" (GM) after Dr. Harold T. Gordon, whose synthetic cockroach-diets (unpublished) have served as models (with modifications appropriate to a liquid as opposed to dry diet and with certain other changes). Our first GM is a mixture of 18 L-amino acids, D-glucose, "structural compounds" (choline, *i*-inositol, 4 ribonucleotides plus thymine), ascorbic acid, 13 B-vitamins and related growth factors, and salts of 13 elements (in addition to H, C, N, O, P, and S). In GM, *C. briggsae* slowly grows almost to maturity. By contrast, with the addition of the standard liver medium (LM) at a level as low as 1/50 of that usually employed, maturation of the first generation is almost as fast as in full strength LM; growth continues thereafter, but at a slower rate. When GM (double strength) is diluted 1:1 with LM, growth of first and subsequent generations is considerably stimulated over that on LM alone (full or half strength); this effect has been shown to be due largely or entirely to certain salts and vitamins. It should now be possible to establish requirements for various GM components and to work toward identification of additional substances occurring in liver and apparently required by *C. briggsae.*

[Supported by grants to the Kaiser Foundation from the National Science Foundation (G-935) and National Institute of Allergy and Infectious Diseases, National Institutes of Health, U.S.P.H.S. (E-926).]

22. **Notes on the Habitat and Tissue-phase of *Ascaridia galli* (Schrank, 1788).** J. F. MORAN JR. AND J. D. MIZELLE, University of Notre Dame, Notre Dame, Indiana.

Daily examination of chicks, each inoculated with 800 infective eggs of *Ascaridia galli* revealed that the posterior third of the intestine is a significant and heretofore unrecognized habitat of this parasite. The greatest concentration of *A. galli* was in a section of the gut extending 3–5 inches on each side of the yolk-sac diverticulum. Significant population shifts from the middle third of the intestine to the anterior and posterior thirds of the intestine occurred between the 8th and 16th day after inoculation. Further population shifts toward the posterior third of the intestine occurred between the 17th and 24th day after inoculation.

The present investigation revealed that 99.6% of infecting larvae remained in the layer of mucus adherent to the intestinal wall, after the gut is flushed with water under pressure. Penetration of the intestinal mucosa by *A. galli* larvae was rare (0.4%). The digestion technique of Tugwell and Ackert (J. Parasitol. **38**: 277–288) was found invalid for separating larvae contained in the layer of mucus next to the gut wall, and tissue-phase larvae.

Infective eggs hatched in the anterior third of the intestine as early as 30 minutes after inoculation. Hatching did not occur in the crop, proventriculus, or gizzard. Recovery of larvae 24 hours after inoculation indicated that most *A. galli* eggs hatch during this period. Immature *A. galli* recovered in the intestinal layer of mucus 50 days after inoculation indicate that larvae may exist in a "static" condition for considerable periods.

23. **Methods for Securing Infective Eggs of *Syphacia obvelata* from Infected Mice.** K. F. CHAN, Columbia University School of Public Health and Administrative Medicine.

Syphacia obvelata has been used by various investigators for chemotherapeutic studies. While it is relatively easy to obtain both qualitative and quantitative infections of *S. obvelata* in mice through the association of negative and infected animals, it is desirable for certain studies to produce experimental infections by feeding a known numbers of eggs. Because of the difficulty in recovering sufficient numbers of eggs in the perianal region of mice and the failure of eggs from gravid females in the cecum to develop cultures *in vitro*, it has been necessary to employ migrating worms as a source of the infectious eggs. We have been routinely employing the following methods for securing migrating worms from infected animals.

Male mice, 3 to 4 weeks old weighing between 15–20 grams obtained from a nematode-free colony, were placed in contaminated pans with heavily infected *Syphacia* "source" mice for 24 hours. These mice were sacrificed between the 12th and the 14th day of infection, the period of maximal migration of the worms depending upon the age and weight as well as the size of the infections. Mice infected in this manner were found to harbor on the 13th day about 100 worms, 20 to 30 per cent of which were in the lower large intestine. These worms, migrating from the cecum to the anus, were in the 11–12-day stage of development. The lower colon of these animals was opened in normal saline where the worms shed their eggs instantaneously into the solution. These eggs were then incubated at 37° C for 3 to 5 hours until the embryos showed active motility and were infective for mice. It has been found that completely developed *Syphacia* eggs withstand low temperatures up to 14 days in normal saline; hence the eggs may be stored at 1–4° C for future use. Normal saline is employed because the eggs hatch in water or hypotonic solutions.

Mice of similar age and weight were fed 300 infective *Syphacia* eggs through a stomach tube, producing a worm burden of about 200 worms. These mice, if killed after 12 to 13 days, yielded as many as 80 migrating worms with each worm depositing over 300 eggs. In general, a 12-day period appears to show maximal migration of the worms for this size of infection.

24. **Further Studies on Strongyloidiasis in Lambs and Kids: Development of Acquired Resistance.** J. H. TURNER, Animal Disease and Parasite Research Branch, Agricultural Research Service, Beltsville, Maryland.

The writer reported (1955, Proc. Helminthol. Soc. Wash. **22**: 132–133) that parasite-free lambs were severely affected when exposed to single, cutaneous applications of 25,000 to 1,000,000 infective larvae of *Strongyloides papillosus*. Animals exposed to 100,000 or more larvae died, whereas the others were affected to a lesser extent. A brief summary of further work on the development of acquired resistance to infection with *S. papillosus* in lambs and kids follows.

Immunizing infections were induced in paired, parasite-free lambs in isolation pens by cutaneous applications of 10,000, 20,000, or 30,000 larvae at 2-day intervals for 20 days. Also lambs and kids were initially infected by cutaneous exposures of 30,000 larvae each, and then

grazed on a clean pasture where they were subsequently exposed to larvae of *S. papillosus* developing from eggs in their droppings. None of these animals developed acute symptoms. Half of the infected animals in pens and all on pasture were challenged several weeks thereafter by single, cutaneous exposures to 300,000 larvae, normally lethal for susceptible lambs and kids. Parasite-free controls were similarly exposed.

The previously infected animals showed little effect of the challenge infection. However, 2 of the 3 parasite-free control animals, also exposed to 300,000 larvae at the time of challenge, died, and the third was severely affected. It is concluded, that lambs and kids rapidly develop resistance to *S. papillosus* when appropriately exposed to infection with this parasite, and that susceptible animals are severely affected when heavy infections are rapidly acquired.

25. **Parasites of the Barbary Sheep.** Rex W. Allen, Willard W. Becklund, and Roy E. Gilmore, Animal Disease and Parasite Research Branch, A.R.S., U.S.D.A., State College, New Mexico.

Although the Barbary sheep (*Ammotragus lervia*) apparently has been a resident of zoological gardens and private game farms in this country for many years, there is a paucity of information about its parasites. In recent years, there has been an increased interest in the Barbary sheep, a native of North Africa, as a game animal, and a herd has been introduced on the open range in New Mexico. The fact that this same range is used by domestic stock adds to the importance of the findings listed here.

This preliminary report is based on post-mortem examinations of 2 host animals from the above-mentioned New Mexico herd. The following parasites were found: *Dermacentor albipictus, Thysanosoma actinioides, Haemonchus placei, Pseudostertagia bullosa, Ostertagia orloffi, Trichostrongylus axei, T. colubriformis, T. vitrinus, T. longispicularis, T. probolurus, Cooperia oncophora, Nematodirus helvetianus, N. spathiger,* and *Skrjabinema* sp. The last named was tentatively identified as *S. ovis.* The most numerous parasites were the pinworms. *T. longispicularis, T. probolurus,* and *O. orloffi* are little known in this country.

(This work was carried out in cooperation with the New Mexico Agricultural Experiment Station.)

26. **Stability of Phenothiazine in Cane Molasses in the Control of Gastro-Intestinal Nematodes of Cattle.** Joseph E. Alicata and James H. Koshi, University of Hawaii.

The use of molasses as a vehicle for low level feeding of phenothiazine to cattle has not had wide application for reason that stability of the drug under this condition has not been known. In this study phenothiazine was mixed with molasses so that 20 cc of the mixture contained 2 grams of the drug. After room storage of 1 and 2 months the mixture was fed in gelatin capsules to 6 heifers infected with gastro-intestinal nematodes. Each animal received daily for 8 days 1 capsule containing 20 cc of the mixture. Furthermore 2 other heifers received daily for 8 days 1 capsule containing 2 grams of phenothiazine without molasses. Three separate fecal samples (20 grams each) were secured from the animals before treatment and 3 separate samples on alternate days beginning with the fifth day of treatment. One sample was collected 1 week after the treatment was discontinued. (The average number of nematode larvae recovered from the fecal cultures previous to treatment from the 6 heifers receiving the molasses-phenothiazine mixture ranged from 100.6 to 2,047.3, and during treatment, from 0 to 6.3. Similarly, counts from the 2 heifers which received phenothiazine only, were 48.3 and 320.6 before treatment and 1.0 and 0.0 during treatment. One week after the feeding of phenothiazine was stopped the larval count for all the animals increased and ranged from 23 to 973.

From the above findings it is concluded that phenothiazine retains its stability when mixed with molasses up to a period of at least 2 months and possibly longer.

27. **The Vector of Canine Filariasis.** Leo Kartman, U. S. Public Health Service, San Francisco 18, California.

A critical historical review of the evidence upon which our knowledge of vectors of *Dirofilaria immitis* is based suggests that quantitative data are generally lacking. The published evidence indicates that both mosquitoes and fleas may act as vectors. Although the hypothesis of the flea vector is an attractive one, the present state of knowledge leaves much to be explained. For instance, there is no clear cut information on the mode of escape of the infective filarial larva from the intact flea host.

Many of the factors relating to the invertebrate host-parasite relationship are examined. It seems clear that we shall not be "possessed of the finite data" until adequately controlled parallel experiments are set up to test the comparative vector efficiency of fleas and mosqui-

toes. There is also a lack of quantitative surveys in enzootic regions designed to correlate the ecology of suspected vectors with the prevalence of the parasite and the disease. Thus our present information regarding the transmission of *D. immitis* by suspected invertebrate vectors is to a great extent speculative rather than substantive.

28. **Evaluation of the Efficacy of Piperazine Adipate for the Treatment of Patients with Trichuriasis.** CLYDE SWARTZWELDER, JOSEPH H. MILLER AND WILLIAM W. FRYE, Louisiana State University School of Medicine, New Orleans; AND RALPH LAMPERT, State Colony and Training School, Pineville, Louisiana.

A 3-day treatment with piperazine adipate was reported to have eliminated *Trichuris trichiura* infections in 90 per cent of a series of patients (Dunn, 1955, Lancet **268**: 592). The daily dosage used by Dunn was 300 mg per year of age, with a maximum of 1.8 grams. A similar treatment schedule employed by the writers in a few cases of trichuriasis failed to eradicate the infection. An effort was then made to evaluate more adequately the efficacy of piperazine adipate against *T. trichiura*.

Egg counts were done on stools collected before and after therapy from 32 patients and stools obtained on the same days from 24 untreated control patients with trichuriasis. All patients were housed on the same ward. The egg counts before therapy in the treated group ranged from 100 to 19,300 per ml. Thirty-two patients with trichuriasis were given 2 grams of piperazine adipate, supplied as a suspension by Burroughs Wellcome and Co., in single daily doses for 20 days. The total dosage was 40 grams. The treated patients were adults of 16 to 71 years. The weights ranged from 62 to 156 pounds. There was no significant reduction in the egg counts in either the treated or in the untreated control group. There was no apparent therapeutic effect of this long course of treatment on concurrent infections with hookworm or *Strongyloides stercoralis*. Despite close observation, no untoward reactions were observed during therapy.

29. **On the Unusual Hatching Posture of the Embryo of** *Trichuris vulpis in vitro*. L. M. YUTUC, University of the Philippines.

Two ways of exit of the embryo from the shell have been described, namely, through one of the poles of the egg with the anterior end coming out first, and the other through a rent in the shell wall with the plug-like knobs *in situ* (J. Parasitol. (Suppl.) **41**: 46–47, 1955; Phil. Jour. Sci. **85**: In press). Further studies on hatching *in vitro* showed a number of embryos with the middle segment doubled up, coming out of one of the poles of the shell first. In some, the embryo in its attempt to free itself, was able to push through the other opening with the anterior end while the middle segment and the tail end were still inside the shell. Further efforts invariably ended in a "ringed" embryo. In others, the embryo was able to extricate itself partly by disengaging the posterior end first and the anterior remained enclosed by the shell. A second unusual hatching consisted in the embryo emerging at the same time, the anterior end in one opening, the posterior in the other, resulting also in a "ringed" embryo. The third form, which is very rare, consisted in the anterior and posterior ends of the embryo emerging simultaneously through one of the apertures of the shell. Essentially all these belong to the first form of exit of the embryo already reported but the postures of the embryos are considered unusual.

30. *Trypanosoma cruzi* **in Raccoons from Maryland.** BRYCE C. WALTON, PRESTON M. BAUMAN, Walter Reed Army Institute of Research; LOUIS S. DIAMOND, Animal Disease and Parasite Research Branch, ARS, U. S. Department of Agriculture; AND CARLTON M. HERMAN, Patuxent Research Refuge, U. S. Fish and Wildlife Service.

Three raccoons trapped at Patuxent Research Refuge, Laurel, Maryland were found to have trypanosomes in the blood which were morphologically indistinguishable from *Trypanosoma cruzi* on stained smears. The organism grew well on a diphasic blood agar medium and reproduced and developed in *Triatoma protracta*. Experimental infections were produced in raccoons, mice, and rats by subcutaneous inoculation of infective blood, culture, and triatome forms. Typical leishmaniform bodies were found in cardiac fibers on sectioning tissues from naturally and experimentally infected raccoons developed high titer reactivity in complement fixation tests using *T. cruzi* (Brazil strain) antigen. On the basis of morphology, leishmaniform tissue stages, development in triatomes, infectivity to a variety of mammals, and cultural characteristics, this trypanosome is considered to be *T. cruzi*.

31. **Susceptibility of Domestic Animals to Infection with *Trypanosoma cruzi* from the Raccoon.** LOUIS S. DIAMOND AND ROBERT RUBIN, Animal Disease and Parasite Research Branch, ARS, U.S.D.A. Research Center, Beltsville, Maryland.

As part of studies on the biology of *Trypanosoma cruzi* recently isolated from raccoons trapped at the Patuxent Research Refuge, U. S. Fish and Wildlife Service, Laurel, Maryland, tests were made to determine the susceptibility of certain domestic animals to this parasite. Mixed 14- and 28-day-old cultures were inoculated into the popliteal space of 6 pigs, 4 lambs, and 2 kids, all 1 day old, and the course of infection was followed by means of thick and thin blood smears and blood cultures.

All inoculated animals became parasitized. In sheep and goats a low-grade, short-term parasitemia appeared during the second week and persisted for 3 to 9 days. Parasitemia was not observed in the pigs; an early parasitemia would have escaped detection because the first blood smears were not made before the twentieth day after inoculation.

Blood cultures of heart or jugular blood showed that a latent infection persisted for at least 8 weeks in pigs and sheep and 4 weeks in goats.

None of the inoculated animals showed symptoms of disease; gross pathology indicative of the infection was not oberved at autopsy. Typical leishmaniform bodies were found in the heart muscle of pig and goat.

Control animals housed with the infected ones have remained free of trypanosomes, as determined by frequent blood culture.

32. **Antitrypanosomal Activity of Structural Variants of Stylomycin® Puromycin.** R. I. HEWITT AND A. R. GUMBLE, American Cyanamid Company.

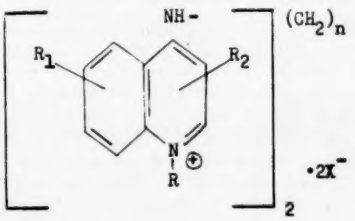
Stylomycin® puromycin, or 6-dimethylamino-9-(3′-*p*-methoxy-L-phenylalanylamino-β-D-ribofuranosyl) purine, is an antibiotic with antibiotic properties isolated from *Streptomyces alboniger* (Porter *et al* 1952, Antib. and Chemo. **2**: 409–410; Waller *et al* 1953, J. Am. Chem. Soc. **75**: 2025). The *in vivo* effects against *Trypanosoma equiperdum* of analogs with substitutions in the 3′ position other than *p*-methoxy-L-phenylalanine have been described previously (Hewitt *et al* 1955, Antib. and Chemo. **3**: 139–144). Several of these were from 2 to 4 times more active than puromycin, including 6-dimethylamino-9-(3′-deoxy-3′-amino-β-D-ribofuranosyl) purine. Variants in position 6 of this structure were then prepared (Goldman *et al*, to be published). A number of these, including the diethylamino, isobutylamino, dipropylamino, (methyl) propylamino, and (ethyl) propylamino analogs, are from 8–32 times (slightly less on a molar basis) more effective than puromycin against *T. equiperdum* in mice.

Since preliminary results with puromycin in the oral treatment of human trypanosomiasis due to *T. gambiense* have been somewhat encouraging (Trincão *et al* 1955, Am. J. Trop. Med. and Hyg. **4**: 13–17), it is possible that one of the above structural variants may be even more effective for this purpose.

None of these compounds hitherto tested have conferred protection at tolerated doses against the development of infections in mice when introduced parenterally 1 week before inoculation with trypanosomes.

33. **Studies on the Activity of Bis-quinaldines against Experimental Trypanosomiasis.** G. F. OTTO, J. C. MOETSCH AND R. U. SCHOCK, Abbott Laboratories.

This group of compounds has been under experimental study in our laboratory for some years. Certain of the bis-quinaldine bases have shown marked activity against some of the trypanosomes in experimentally infected mice, whereas the quaternary bis-quinaldines have shown activity against other species in similar animals. Time will permit only a brief review of the activity against one species, *Trypanosoma congolense*. The quaternized bis-quinaldines have been conspicuously more active than the bases against this species. These have the general formula, where X^- is an inorganic or organic anion and R, R_1, and R_2 are various substituents:—



The activity has been greatest against *T. congolense*, so far, when n=6. In such compounds marked activity has been found in single doses as low as 0.01 mg/kg intramuscularly and 0.1 mg/kg *per os*. On direct comparison several of them are more active than Antrycide.

34. **A Method for Screening Compounds Against Visceral Leishmaniasis in the Hamster.** ELIZABETH M. FRANCHINO, JOHN GRUN AND LESLIE A. STAUBER, Rutgers University, The State University of New Jersey.

An 8-day method of screening compounds against the Khartoum strain of *Leishmania donovani* in the golden hamster is now available. Infection is accomplished by the intracardial inoculation of 0.1 ml of suspension of ground infected spleen in saline. The number of parasites (approx. 1–10 million) inoculated is such that, 1 hour after inoculation, enough parasites are found in liver impression smears of the hamsters to furnish a satisfactory point for comparing the number changes occurring in untreated and treated animals over the 8-day period. Administration of the compounds has been by the subcutaneous and intraperitoneal routes; it is started 24 hours after inoculation of parasites, and is performed daily for a total of 6 days. On the 8th day necropsies are performed and the liver impression smears, for the final parasite counts, are made.

The following compounds have been used in developing this method: sodium stibogluconate, stibophen, cortisone and actinomycin D. As previously reported (Stauber, 1955) there is an almost exponential rise of parasite numbers in the liver over the first 8-day period after intracardial inoculation. With inactive compounds, like cortisone and actinomycin D, the slope of the line of parasite increase over the 8-day period is unaltered. With a highly active compound, like sodium stibogluconate, as little as 9 mg per 100 gm body weight per day has been shown to inhibit completely the expected increase in parasite numbers. The method appears to be sensitive and economical and the results easy to express in terms of stibogluconate equivalents.

[This investigation was supported by a research grant (E-91) from the National Institute of Allergy and Infectious Diseases, of the National Institutes of Health.]

35. **Experimental Infections of the Genital Tract of Swine and Goats with *Tritrichomonas foetus* and *T.* species from the Cecum of Swine.** DATUS M. HAMMOND* AND W. LEIDL, Gynecological and Ambulatory Veterinary Clinic of the University of Münich, Professor W. Baier, Director. (*During 1955–1956 grantee of a Fulbright Research Scholarship while on leave from Department of Zoology, Utah State Agricultural College.)

Of 3 sows inoculated intravaginally at estrus with *T. foetus* cultures only 1 showed a demonstrable infection on the first trial, while a second was infected following a second trial. Trichomonads were present in low or moderate concentration in vaginal samples for about a week following inoculation. Of 3 sows similarly inoculated with trichomonad cultures from the cecum of a pig all became infected on the first trial. The infection was demonstrated for about 10 days in 2 of the sows and for about 5 weeks in the third. Trichomonad numbers were relatively high in 2 of the 3 cases. These results indicate that of the 2 trichomonad species, *T. foetus* is less adaptable to the genital tract of the sow. No demonstrable infection resulted from inoculations with either species of trichomonad in the preputial cavity of a boar. After a goat was inoculated intravaginally with *T. foetus* cultures vaginal samples were positive for 3 weeks; the goat was then slaughtered and trichomonads were found in large numbers in the vagina, cervix and all parts of the uterus. Two other goats inoculated intravaginally with *T. foetus* cultures also became infected. Four goats inoculated 2 or more times intrapreputially with *T. foetus* cultures remained negative. There were no apparent pathological effects of any of the infections. These results indicate that *T. foetus* is able to become established in the female genital tract of the goat, but not in the preputial cavity.

36. **Observations on Vaginal Trichomoniasis in Monkeys.** E. EUGERE, V. LYNCH, AND R. K. THOMS, The University of Connecticut.

To date reports on vaginal infections of *Trichomonas vaginalis* in monkeys have indicated that no symptoms are produced and that only a portion of the monkeys inoculated are susceptible. In our laboratory 5 *Macacus rhesus* and 3 *Macacus cynomolgus* have undergone repeated intravaginal inoculations with bacteria-free cultures of *Trichomonas vaginalis* with failure to establish infections in only a negligible number of cases. In the *Macacus rhesus*, symptoms appeared similar in some respects to those in humans while the *Macacus cynomolgus* remained asymptomatic.

37. **The Inhibitory Effects of an Ion Exchange Resin on** *Trichomonas vaginalis.* E. EUGERE, V. LYNCH, AND R. K. THOMS. The University of Connecticut.

In 1955 Folsome, Leslie, and Thoms demonstrated the inhibitory effects of a carboxylic acid type ion exchange resin on a number of lower genital tract infections in humans and on *Trichomonas vaginalis in vitro.* In the present study we have shown that when human serum is treated with the ion exchange resin and the treated serum added to Simplified Trypticase Medium, normal growth will not occur. However, with the addition of the treated serum plus glutamine or the ion exchange resin eluate, normal growth does occur. This tends to confirm the work of Back *et al* concerning the necessity of glutamine for the growth of *Trichomonas vaginalis.*

38. **Adaptation to Carbohydrate Substrates and "Direct" Utilization of Maltose by** *Trichomonas.* C. P. READ, The Johns Hopkins University.

Attempts have been made to increase the capacity of *Trichomonas gallinae* to grow on some poorly utilized carbohydrate sources. Rapid adaptation to galactose occurs, the organisms showing a marked increase in growth rate and number of cells produced after 1 transfer in galactose medium. However, after 15 transfers in sucrose medium there is no enhancement of sucrose utilization as indicated by growth or manometric studies.

Trichomonas vaginalis and *T. gallinae* attain higher populations in media containing maltose than in media containing glucose. Data will be presented to show that this is not related to total carbon, osmotic effects, alteration of pH, nor to rapid removal of glucose by the organisms. A dialyzed cell-free preparation of *T. gallinae,* poisoned with iodoacetate, has been found to catalyze the reaction, $n\ maltose \rightarrow n(glucose) + n\ glucose$. This polysaccharide synthesis does not require adenosine triphosphate nor inorganic phosphate. The system resembles the amylomaltase reported to occur in *Escherichia coli.* The possible significance of the enzyme in the biology of *Trichomonas* will be discussed.

39. **Furazolidone as a Therapeutic Agent in Pigeon Trichomoniasis.** ROBERT M. STABLER, Colorado College, Colorado Springs.

The nitrofuran Furazolidone, or N-(5-nitro-2-furfurylidene)-3-amino-2-oxazolidone), supplied by the Eaton Laboratories, Norwich, N. Y., was tried in pigeon trichomoniasis caused by *T. gallinae.* Dosages of 200, 100, 50, and 35 mg of furazolidone per day per bird for 7 days proved highly toxic. Whereas these doses frequently removed *gallinae* from chronic carriers, the birds went into convulsions and most of them died. Two pigeons became only mildly ill at a dosage of 25 mg per day per bird and lost their trichomonads. Twelve birds were next given 10 mg per day per bird for 7 days. Of these, none was ill; only 2 became free of *gallinae.*

Fifteen non-immune, trichomonas-free pigeons were then given the highly lethal Jones' Barn strain of *gallinae.* Of these, 6 were kept as controls and 9 were started on 10 mg furazolidone per day per bird for 7 days. The 6 controls died. Of the treated birds; 1 died in convulsions, 2 died of severe trichomoniasis, and 6 survived both the drug and the parasite. Of the survivors, only 1 became free of *gallinae.*

Furazolidone, then, appears entirely too toxic at effective therapeutic levels to be used in pigeon trichomoniasis. It seems capable of preventing some death in non-immune pigeons infected with highly virulent *gallinae.*

40. **Studies on the Pathology of Experimentally Produced Blackhead in Turkeys.** T. D. MALEWITZ, Michigan State University.

Blackhead was experimentally produced in turkeys by the oral inoculation of 300–600 embryonated *Heterakis gallinae* eggs. Blood studies revealed a decrease in the total red blood count, hemoglobin, and white blood cell count. The heterophils increased while the lymphocytes decreased. Monocytes, eosinophils and basophils remained within normal range. The temperature rose during the infection and was sub-normal at the time of death.

Typical gross lesions produced by *Histomonas meleagridis* were observed in the liver and ceca of the 8 infected turkeys. Gross lesions were also observed in the spleen, kidney, and lungs.

Microscopic lesions, in which the parasite could be demonstrated, were observed in the ceca, liver, kidney, and spleen. These lesions were characterized by hyperemia, hemorrhage, lymphocytic infiltration, presence of giant cells, necrosis, and usually a serous exudate. The lung, pancreas, and heart exhibited lesions characterized by hyperemia and a sero-cellular exudate. Lymphocytic infiltration was observed in the lungs. Parasites were not demonstrated in the lung, pancreas, or heart.

41. **Apropos Oöcyst Measurements.** ELERY R. BECKER, Iowa State College.

The author and collaborators have carried out more or less extensive sets of measurements (length and width) on 6 of the 8 *Eimeriae* known for chickens. All are given in microns.

Eimeria maxima ranged from 26.9–35.4 by 20.9–25.1; mean, with S. D., $31.84 \pm 1.44 \times 22.7 \pm 0.86$; shape index, 1.40.

E. brunetti: range, 13.8–33.7 × 12.4–28.3; mean, $23.4 \pm 2.00 \times 19.7 \pm 1.70$; S. I., 1.19.

E. tenella: range, 14.2–31.2 × 9.5–24.8; mean, $22.96 \pm 2.20 \times 19.16 \pm 1.69$; S. I., 1.20.

E. necatrix: range, 12.1–28.9 × 10.7–23.8; mean, $19.70 \pm 1.82 \times 16.70 \pm 1.20$; S. I., 1.18.

E. acervulina: range, 11.7–22.7 × 9.2–17.5; mean, $16.40 \pm 153 \times 12.97 \pm 1.18$; S. I., 1.26.

E. mitis: range, 9.9–21.5 × 8.5–17.7; mean, $15.78 \pm 1.62 \times 13.39 \pm 1.27$; S. I., 1.18.

The stated mean size of *E. mitis* is the average 2 "strains." The sizes stated for *E. necatrix* and *E. acervulina* are not in agreement with Tyzzer's measurements. Definitely saddle-shaped bimodal curves were not obtained for length or width measurements in samples of 50 to 100 oocysts.

42. **Morbidity and Mortality among Chickens Infected with Large Numbers of the Intestinal Coccidium, *Eimeria acervulina* Tyzzer, 1929.** NEAL F. MOREHOUSE AND W. C. MCGUIRE, Dr. Salsbury's Laboratories, Charles City, Iowa.

A mortality of 6.3% of 16 chicks was obtained with a single crop inoculation of approximately 5 million oocysts of the intestinal coccidian species, *Eimeria acervulina*. The same quantity of oocysts given on 2 and 3 consecutive days resulted in 12.2 and 21.1% mortality of 74 and 19 chicks respectively. Mortality as high as 75% was obtained when chicks received daily infection with 5 million oocysts for at least 4 days or 20 million for 2 consecutive days. No mortality was observed among chicks receiving 100,000 to 1 million oocysts per bird either in single or multiple daily doses although body weight loss was observed at all dosage levels used. These losses ranged up to 27.3%

Chicks receiving a single infection with 5 and 10 million oocysts discharged up to 6.47 and 7.74 million oocysts per gram of feces during a single 24-hour period with daily averages of 4.81 and 4.72 million oocysts per gram during the first 4 days of the patent period of the disease.

White opacities resulting from colonies of developing parasites were visible through the serosa of the small intestine of lightly infected chicks but the mucosa was not extensively reddened by inflammation. Such white opacities were rarely seen in the intestines of chicks receiving at least 1 million oocysts. The mucosa usually had a bright red color resulting from extensive inflammation. These differences will be illustrated by color slides.

43. **The Coccidiostatic Activity of Soluble Furacin Against *Eimeria necatrix*.** R. F. SHUMARD, North Dakota Agricultural Experiment Station.

Preliminary studies to determine the toxicity and most effective dose of a water soluble nitrofuran against *E. necatrix* were conducted. A dosage of 0.008% of the drug in water proved to be the most effective. The drug, at this level, is effective in preventing mortality due to *E. necatrix* when given on the day of oocyst administration or on the first, second, third or fourth days following oocyst administration. In all cases drug was given for at least seven days following administration of oocysts.

Challenge doses of 5, 6, 7, and 8 times the original number of oocysts administered to replicate lots on the 14th, 21st, 28th, and 35th days respectively following initial administration of oocysts, showed that the drug did not interfere with the development of immunity to this species of coccidian.

44. **The Effect of Allyl Acetone in the Treatment of Experimentally Induced Cecal Coccidiosis in Chicks.** WILLIAM A. URICCHIO, Mount Mercy College.

Because of results obtained in earlier experiments, series of tests were conducted using allyl acetone ($CH_2 = CH \cdot CH_2CH_2CO \cdot CH_3$) to treat young chicks infected with sporulated oocysts of *Eimeria tenella*. The factors that varied were: the concentration of the chemical, time and number of days the chemical was administered, and the age of the chicks. The tests showed that chicks given the chemical soon after they were infected passed smaller amounts of blood and also had a lower mortality rate. However, at no point in the studies did the chemical prove to be sufficiently effective to be useful on a practical basis.

45. **The Optimum in Coccidiostatic Activity.** PAUL D. HARWOOD, DOROTHY I. STUNZ, AND ROBERT W. WOLFGANG, Hess and Clark, Inc.

The most desirable level of coccidiostatic activity is as near complete protection as possible without deleterious side-effects. Complete inhibition prevents development of immunity which is objectionable in replacement flocks although it may be tolerated among broilers. Discovery of a drug which will destroy an intracellular parasite or inhibit its development without affecting the host in some manner has not been accomplished to date and may not be possible. All known coccidiostats affect host tissues, as well as parasites, possibly because coccidia develop intracellularly. The effects of a drug fed continuously upon a host are not easily determined. These effects may be beneficial, such as an improved feed conversion, or detrimental, such as retarded growth. Furthermore, a coccidiostat may protect against diseases other than coccidiosis or it may increase susceptibility to injurious attack by other types of pathogenic organisms. Since many of the most destructive diseases of poultry are caused by bacteria and viruses, the effect of coccidiostats upon diseases other than coccidiosis may prove of crucial importance. A study of drug-activity in pure infections of each disease may not be feasible. Nevertheless, valid estimates of the over-all effects of drugs can be obtained by observing controls and treated groups under conditions of natural, but not artificial, infection. The application of these principles to research on coccidiosis and to development of useful coccidiostats will be illustrated by experimental results obtained with drugs which are important in the field.

46. **The Reproductive Habits of *Plasmodium cathemerium* in Chick and Duck Embryos.** R. B. MCGHEE, University of Georgia.

The injection of chick embryos with canary blood infected with *Plasmodium cathemerium* produced no discernible infection. Inoculation of the same quantity of parasites into duck embryos resulted in an initial low grade infection which gradually increased over a period of several days. Early passages in duck embryos were marked by a fluctuating course of infection with the number of parasites never exceeding 5 per 100 erythrocytes. Subsequent passages were characterized by an ever increasing number of parasites until peaks of 120 parasites per 100 erythrocytes were frequent. The percentage of segmenting forms in 9 embryos was determined by blood films made at 2-hour intervals. In these embryos there was but 1 period of maximum segmentation which occurred between 8 P.M. and 12 midnight of the second day.

Injection of heavily infected duck embryo blood into chick embryos produced a low grade but consistent infection never exceeding 5 parasites per 100 erythrocytes. Embryos remained infected for as long as 10 days but did not survive hatching.

47. **The Life Cycle of *Gregarina hyalellae* a Gregarine Parasitic in *Hyalella azteca*.** D. DEGUISTI AND S. DELIDOW, Wayne University, Detroit, Michigan.

The amphipod *Hyalella azteca* ingests the sporocysts of *Gregarina hyalellae*. The sporozoite penetrates the epithelial cells of the amphipod intestine. The cephalont develops intracellularily until it achieves a length of 15 to 20 microns; it then leaves the cell and becomes a sporont inhabiting the intestinal lumen. Mature sporonts associate in pairs (Syzygy). A cyst wall first of a mucoid nature forms to surround pairs in syzygy, later this mucoid cyst is replaced by a more definitive oocyst wall. Shortly after encystment, nuclear division occurs in each of the associated individuals, gametic nuclei are established in approximately 2 hours after association and cyst formation. Pairing and fusion of the gametic nuclei (fertilization) is accompanied by churning protoplasmic movements lasting for about 15 minutes. After fertilization sporoblastic areas are formed; sporocyst walls appear ½ hour after fertilization is complete. After 2 hours, sporozoites develop within the sporocyst. Sporozoites are liberated by simple rupture of the cyst wall.

48. **Electrophoretic Studies of Plasma Proteins in Dogs with Amebic Dysentery.** EDWARD O'B. COMER, Veterans Administration Hospital; J. CLYDE SWARTZWELDER, Louisiana State University School of Medicine; AND CHARLES A. JONES, Veterans Administration Hospital, New Orleans, Louisiana.

The dysentery which occurs in dogs infected with *Entamoeba histolytica* is aggravated and prolonged by a salmon diet. Electrophoretic analyses of plasma proteins were made to determine the changes in protein fractions before inoculation, during active infection, and after spontaneous cure of infection in dogs on (1) a balanced kennel ration and (2) a salmon diet. Nineteen dogs were used in the study. Infections were induced by intubation *per anum* of dysenteric aspirate. Electrophoresis was performed with a Tiselius apparatus, using a

veronal buffer of pH 8.6. The number of plasma samples fractionated was 155. The means, in grams per cent, for total protein, albumin and gamma globulin, respectively, were: (1) kennel ration before inoculation, 4.82, 1.52 and 0.56; during infection, 4.26, 1.17 and 0.58; after infection, 5.03, 1.74 and 0.60; (2) salmon diet before inoculation, 5.25, 1.97 and 0.62; during infection, 4.88, 1.62 and 0.55; after infection, 5.25, 1.96 and 0.66. Although considerable variation in all protein fractions occurred in individual animals, there was a decrease in the means of total protein and albumin during active infection in both series. In contrast, the means of gamma globulin showed no significant change. The marked increase in gamma globulin concentration which occurs in some protozoan diseases was not observed during amebic infection in dogs. The exacerbation and prolongation of amebic dysentary in dogs by salmon was not reflected by significant changes in gamma globulin level. In fulminant fatal infections there was a rapid decrease in all protein fractions measured.

49. **An Ecological Study on *Hysteromorpha triloba* (Trematoda: Strigeida) at Oakwood Lakes, South Dakota.** ERNEST J. HUGGHINS, South Dakota State College, Brookings.

Since working out the life history of *Hysteromorpha triloba* in Illinois [1953, J. Parasitol. **39** (Suppl.): 15; 1954, Trans. Amer. Micro. Soc. **73:** 1, 221; and 1956, Trans. Amer. Micro. Soc. **75:** (in press)], the writer has found the metacercariae of this trematode in many black bullheads, *Ameiurus melas,* from 6 lakes in eastern South Dakota. At East Oakwood Lake near Brookings, S. Dak., the snail first intermediate host, *Gyraulus hirsutus,* was collected in the vicinity of a rookery of double-crested cormorants, *Phalacrocorax a. auritus,* the definitive host. Practically all of 194 snails collected in July, 1953, liberated cercariae of *H. triloba.* To determine whether snails carried the infection through the winter, almost 1000 *Gyraulus* were collected from the rookery area in the Spring of 1954 up to June 6. No cercariae emerged. Snails collected on June 13 were the first to liberate cercariae.

In the Spring of 1954, 82 bullheads from the lake were examined, and all but 2 very small fish had varying numbers of metacercariae of *H. triloba.* There was a direct correlation between size of fish and number of cysts. Trautman (1951, S. Dak. Conserva. Digest **18:** 3) had previously examined 157 food samples of cormorants from this lake and found bullheads in 41% of the samples. Thus, the life cycle of *H. triloba* appeared to be well established.

In the Spring of 1955 the cormorants abandoned the rookery because of the opening of a public recreation area nearby. With the departure of the cormorants, the infection in the snails virtually disappeared in the same season.

(This project was supported by a grant from the South Dakota Academy of Science. A full report will appear in their Proceedings, Vol. 35, 1956.)

50. **Further Studies on *Hysteromorpha triloba* (Trematoda: Strigeida), and Some Parasites of a White Pelican.** ERNEST J. HUGGHINS, South Dakota State College, Brookings.

Since pelicans and cormorants are closely related, the writer wanted to know whether pelicans could serve as definitive hosts for *Hysteromorpha triloba,* for which several species of cormorants, *Phalacrocorax,* are the only known definitive hosts. A 15-pound male white pelican, *Pelecanus erythrorhynchos,* was captured at Brant Lake, S. Dak. Tetrachlorethylene was given until fluke eggs ceased to appear in the feces. Then the bird was fed black bullheads infested with metacercariae of *H. triloba.* Three days after the first feeding, fluke eggs very similar to those of *H. triloba* appeared in the feces. The writer (1954) had found that *H. triloba* matures in 3 days in the gut of the cormorant, but on autopsy of the pelican no *H. triloba* were found. The eggs had come from another strigeid, *Bolbophorus confusus,* which were in the upper small intestine. Evidently the tetrachlorethylene had stopped egg production temporarily but had not eliminated the flukes. Brandes (1891) and Stossich (1897) presumably had this same fluke from a pelican and a bittern, respectively, but believed it was *H. triloba.* Krause (1914) finally described the fluke as a new species (Hugghins, 1954, Trans. Amer. Micro. Soc. **73:** 2).

Other helminths found in the pelican were *Oligorchis longivaginosus* (Cestoda: Hymenolepididae) in the upper small intestine, and *Contracaecum spiculigerum* (Nematoda: Anisakinae) in the stomach. Nematode eggs were abundant in the feces throughout treatment with tetrachlorethylene.

Inside the pouch of the pelican were many large Mallophaga, *Piagetiella peralis.* Smaller Mallophaga on the feathers were *Colpocephalum unciferum* and *Pectinopygus* n. sp. (being described by Elbel and Emerson). (The writer is indebted to Dr. K. C. Emerson for identification of the Mallophaga.)

51. **On the Sexual Abnormalities in the Male** *Schistosoma japonicum.* S. Y. Li Hsü and H. F. Hsü, State University of Iowa.

Schistosoma japonicum males, numbering 2416, recovered from hosts which had been infected with male and female cercariae, and 1457 males from hosts which had been infected only with male cercariae, were studied for the number and arrangement of the testes as well as the hermaphroditic abnormalities. The hosts from which the schistosomes were obtained were dogs, cats, goats, water buffaloes, pigs, horses, monkeys, rabbits, guinea pigs, shrews, hamsters, rats and mice. The strains of the parasites included in this study were Formosan, Japanese, Chinese and Philippine.

The importance of sexual abnormalities in the specific and strain characters is discussed.

52. **Studies on Reproduction and Growth of** *Oncomelania nosophora* **and** *Oncomelania quadrasi,* **intermediate hosts of** *Schistosoma japonicum.* Lois Wong and E. D. Wagner, School of Tropical and Preventive Medicine, Loma Linda, California.

The snails used in the study were reared in saucers and Petri dishes by methods found to be successful for laboratory studies. In the studies on reproduction the following average figures were obtained for *O. quadrasi.* The size of the eggs is 0.6 mm (range 0.5–0.9), the incubation period is 18.4 days (range 8–40) and the size of young at hatching is 0.49 mm (range 0.25–0.7). The number of eggs laid per day was 0.7 and the frequency of egg laying varied from 1 to 55 days. For *O. nosophora* the average findings were: Egg size 1.1 mm (range 0.6–1.8), incubation period 20.2 days (range 9–46 days), size of young at hatching 0.57 mm (range 0.31–0.7). The number of eggs laid per day was 0.2 and the frequency was 1 to 51 days.

The growth rates of the 2 species of snails were approximately the same except that for *O. quadrasi* a leveling off occurred at about 12 weeks while for *O. nosophora* this occurred at about 16 weeks when the adult size was attained.

Singly mated *O. quadrasi* produced an average of 127.5 young per snail during an average period of 6½ months, while *O. nosophora* females produced an average of 80 young during a 4-month period.

Snails less than 2½ whorls in size failed to survive a 30-minute period of desiccation. Those 3–3½ whorls in size survived the 30-minute desiccation exposure much better, but most were killed when dried for 15 hours. These data may be helpful in natural methods of snail control against *Schistosoma japonicum.*

53. **The Ecology of Marine Dermatitis-producing Schistosomes. I. Seasonal Variation in Infection of Mud Snails** (*Nassa obsoleta*) **with Larvae of** *Austrobilharzia variglandis.* Carl J. Sindermann, Brandeis University.

Marine schistosome dermatitis in northern New England appears to depend upon the dynamics of infection of 2 migratory populations: The snail intermediate (*Nassa obsoleta*) and the avian definitive host (at least several species of ducks). For 2 years a study has been made of the seasonal migrations and infection percentages of the snail host. The infection appears to be self-limiting in that previously existing infections disappear by late winter, due to death of the snail host, and are replaced by new infections acquired the previous Autumn. Also, infection with larval schistosomes inhibits the normal Autumn offshore movement of the snail host to winter aggregation sites near or below the mean low tide line. This means that snails remaining in the high tide zone in September and October exhibit an extremely high prevalence of larval schistosome infection (up to 31%), furnishing an admirable mechanism for infection of the avian host during its Autumn migration. This also provides for limitation of the infection through death of infected snails in such inshore areas from extremes of winter environmental changes, especially sub-freezing temperatures and icing of the tidal flats. Snails sampled at stations near and below mean low tide exhibit low percentages of infection throughout the year.

It is postulated that larval trematode invasion and subsequent destruction of snail tissue, especially the gonad and digestive gland, may be responsible for the failure of the snail to participate in seasonal migrations, possibly by reducing or eliminating a response to changing photoperiod; and that the infection may be self-limiting in this way.

54. **Transfaunation of** *Schistosomatium douthitti.* Chauncey G. Goodchild, Emory University.

Schistosomatium douthitti removed from lungs, liver, and mesenteric veins of white mice have been successfully implanted into the anterior chamber of the eye of white rats. Flukes were removed from mice between 4–42 days after infection. Rats, about 200 grams in weight,

were etherized and the cornea punctured with a sharp scalpel. Flukes were placed into the anterior chamber by small hypodermic syringe and needle. Inflammation and infection were controlled by cortisone and antibiotic injections. Parasites continued to live and move normally in the experimental habitat. They often lost the normal brownish cecal contents which were replaced by a milky-white fluid made readily visible by peristaltic motions. They were also observed feeding on blood clots resulting from the operation. Flukes crawled over the surface of the iris and often succeeded in reaching the posterior chamber behind the iris. Normal mating and oviposition occurred in the anterior chamber and eggs with miracidia have been recovered. The oldest continuing implant is now 140 days old and gives no indication of debilitation. Indefinite survival of implants seems assured. Growth rates seemed to be depressed in the anterior chamber. For example, flukes 20 days old (about 1.9 mm long) taken from veins are only 1.2 mm long after an additional 20 days in the eye. Forty-day-old flukes from veins average about 2.3 mm in length. Studies on factors responsible for growth lag are now engaging our attention.

55. **Developmental Stages in the Digenea. IV. The Miracidium of *Neorenifer wardi* (Byrd, 1936) and *Dasymetra conferta* Nicoll, 1911.** MARY C. DUNN AND ELON E. BYRD, University of Georgia.

When the eggs of *Neorenifer wardi* (Byrd, 1936) and *Dasymetra conferta* Nicoll, 1911 are ingested in large numbers by *Physa gyrina* Say, many of the hatched miracidia are passed to the outside in the snail's subsequent fecal tubes. The fecal tubes containing the miracidia were treated in 1 of 2 ways: (1) they were transferred to a 0.3% salt solution on a glass slide and covered with a coverglass and (2) they were transferred to a glass slide which had been smeared with Meyer's albumen fixative. To the saline preparations various *intra vitam* stains were added and the miracidia observed during the staining process as well as in subsequent stages until the slide was of no further use. In the *intra vitam* stains the miracidia of *N. wardi* contained from 8 to 10 large, deeply staining nuclei while the miracidia of *D. conferta* always contained 8 such nuclei. In the miracidia of both species there always occurred 2 quite large nuclei, each surrounded by a much larger mass of cytoplasm, and several smaller nuclei, each surrounded by a much less conspicuous cytoplasmic mass. The miracidia fastened to slides with the albumen were fixed in either Gilson's or Schaudinn's fluid and stained with iron hematoxylin. In these preparations as many as 16 large nuclei could be counted in the miracidia of *N. wardi* while the number of such nuclei remained at 8 in *D. conferta*. Up to the present time it is our belief that the nuclei observed belong to the germinal line and that we have been unable to demonstrate the nuclei of the somatic cells.

56. **The Life Cycle of *Plagiorchis parorchis*, n. sp., (Trematoda: Plagiorchiidae).** RALPH W. MACY, Portland State College, Portland, Oregon.

A large percentage of the snail *Lymnaea stagnalis* collected from Cascade Lake, Orcas Island, Washington, was found to be infected with great numbers of a xiphidiocercaria of the Polyadena group of Sewell. They were produced in irregular-shaped sporocysts. The body of the cercaria measured about 0.32 mm long and the tail was about 0.2 mm in length; the stylet was 0.03 mm long; the oral sucker was 0.062 mm long by 0.058 mm wide, and the ventral sucker measured 0.046 mm in diameter. The cercaria was noted to be larger than that of *Plagiorchis micracanthos* Macy as observed by McMullen, 1937, and it was filled with larger concentration granules, measuring up to 0.012 mm in diameter. Encystment was brought about in caddis-fly larvae, and in mosquito larvae. In the latter the cysts measured 0.17 by 0.19 mm, were infective after several days, and matured after being fed to mice. Adults have testes more nearly opposite in position than those of *Plagiorchis micracanthos* from eastern bats, and are considered to be a new species, *P. parorchis*.

(This work was supported by Contract Nonr 1806(00), NR 130-342, between the Office of Naval Research, Department of the Navy, and Portland State College.)

57. **Observations on the Genus *Atrophecoecum* Bhalerao, 1940.** HELEN E. JORDAN AND ELON E. BYRD, University of Georgia.

Two entire and 1 piece of a digenetic trematode belonging to the family Acanthostomatidae Poche, 1926 (apparently of the genus *Atrophecoecum* Bhalerao, 1940) have been recovered from the alligator, *Alligator mississippiensis* (Daudin), from south central Georgia. The specimens appear to be closely related to *Atrophecoecum diploporus* (Stunkard, 1931) with the exceptions that (1) the body is much larger and is wedge-shaped, being much wider anteriorly than posteriorly, (2) there are fewer spines encircling the oral sucker, (3) the suckers are much larger and (4) the cuticle about the genital pore appears to possess a circlet

of rather large spines or prominent wrinkles (?). A structure similar to the genital opening (with spines or wrinkles) also lies immediately behind the ventral sucker. The 2 ceca appear to be normal in development with the exception that each opens to the outside near the caudal extremity of the body.

58. **The Comparative Histochemistry of Alkaline Glycerophosphatase in the Acanthocephala.** WILBUR L. BULLOCK, University of New Hampshire.

The prime site of alkaline glycerophosphatase activity in the Acanthocephala studied was in the outer layer of the subcuticula of the trunk. The inner radial fiber layer of the subcuticula appeared somewhat less active, but the middle layer showed little or no evidence of enzyme activity. The most intense reaction was given by *Pomphorhynchus bulbocolli, Telosentis tenuicornis, Polymorphus* sp., and *Corynosoma wegeneri;* a moderate to strong reaction occurred in *Echinorhynchus gadi, E. salmonis, Fessisentis vancleavei, Illiosentis furcatus, Moniliformis dubius,* and *Macracanthorhynchus hirudinaceus;* consistently negative were *Leptorhynchoides thecatus, Acanthocephalus* sp., and 8 species of Neoechinorhynchidae. The subcuticula of the praesoma was negative for phosphatase activity except in *F. vancleavei* where this region appeared to be more active than the subcuticula of the trunk. The lemnisci were also positive in *F. vancleavei* although negative in all other adults tested.

Larval forms from intermediate and transport hosts were generally negative. However, positive reactions were obtained in the lemnisci of *Macracanthorhynchus ingens* and *Oncicola canis* from abnormal hosts. Some enzyme activity was observed in the inner subcuticular layer of mature cystacanths of *M. dubius;* after less than 1 week in the rat hosts the typical adult pattern was present. By contrast, *F. vancleavei* was negative in the isopod intermediate host and did not exhibit enzyme activity until sexually mature in the fish host.

It is probable that the phosphatase activity of the outer layer is involved in absorption of foodstuffs. The function of the enzyme of other locations is not as clear.

59. **The *in vitro* Fermentation of Carbohydrates by Two Species of Tapeworms and One Species of Acanthocephala.** JOHN S. LAURIE, The Johns Hopkins University.

A preliminary report on the fermentation of carbohydrate substrates by the cestode *Hymenolepis diminuta* has been presented [J. Parasitol. **41** (Suppl.): 29]. This study has been continued with *Oochoristica symmetrica* and *Moniliformis dubius.* The experiments were carried out in a Krebs-Ringer bicarbonate buffer (pH 7.4), gas phase 95% N_2-5% CO_2, at 38° C. The evolution of CO_2 from the buffer served as the criterion for measuring substrate fermentation. This is equivalent to acid production since these worms do not produce any anaerobic, metabolic gas. The measuring technique does not account for the non-acidic products of metabolism. The worms were sexually mature at the time of use.

Unless otherwise stated, all results for the acanthocephalans pertain to both male and female worms. *M. dubius* ferments glucose, galactose, mannose, fructose, and maltose, at least in part, to acidic catabolites. Excluding galactose, the fermentation of the other 4 sugars is inhibited by quinacrine, chloroquine diphosphate, thorazine, and acriflavine but not by phlorizin or dibromophlorizin. *O. symmetrica* ferments glucose, galactose, and mannose. The fermentation of glucose and galactose by this tapeworm is inhibited by quinacrine, chloroquine diphosphate, and thorazine but not by phlorizin or dibromophlorizin. Acriflavine inhibits the fermentation of glucose but not of galactose. Neither species ferments any of the following substances to acidic catabolites: Sorbitol, dulcitol, mannitol, xylose, arabinose, glucosyloxime, glucosamine, 3-O-methyl-D-glucose, 2-deoxy-D-glucose, α-methyl-D-glucoside, gluconic acid, glucuronic acid, mucic acid, lactose, sucrose, and trehalose. In addition, *O. symmetrica* does not ferment fructose and maltose and *M. dubius* does not ferment sorbose, lyxose, rhamnose, i-inositol, cellobiose, melibiose, turanose, raffinose, glycerol, glycerophosphoric acid, and fructose-1,6-diphosphoric acid.

H. diminuta does not ferment arabinose, 3-methoxyglucose, 2-deoxyglucose, or gluconic acid. Glucose (0.01 to 0.06 M) fermentation by this worm is not inhibited by 3-methoxyglucose (0.005 to 0.03 M) nor by 2-deoxyglucose (0.005 to 0.01 M). Chloroquine diphosphate inhibits the fermentation of glucose, thorazine inhibits the fermentation of glucose and galactose, and acriflavine inhibits the fermentation of glucose but not of galactose and mannose by this tapeworm.

H. diminuta differs from the other worms by its fermentation of xylose and its response to phlorizin or dibromophlorizin, and from the acanthocephalan by its uninhibited fermentation of mannose in the presence of acriflavine. The acanthocephalan differs from the tapeworms in its ability to ferment fructose and maltose.

All 4 of the heterocyclic bases evoke a varying degree of contraction in the worms exposed to solutions containing any one of these compounds.

60. **On Treatment of Schistosomiasis Japonicum by Means of Triostam (Sodium Antimonyl Gluconate).** SABURO SUGIURA, Schistosomiasis Department, Yamanashi Prefectural Medical Research Institute, Kofu, Japan.

Triostam (sodium antimonyl gluconate) a trivalent antimony compound was used in the treatment of schistosomiasis japonica. Animals with mature infections were treated with 12 injections at the rate of 15 mg/kg of body weight. Another series of animals was treated similarly beginning 3 days after exposure to cercariae of *Schistosoma japonicum*. In both cases the drug was quite efficacious.

For human infections, trials were made with 6, 8, 9 and 12 daily injections at the rate of 3–5 mg/kg of body weight. All 10 individuals so treated had ceased to discharge eggs within 3 months after treatment. Three persons treated every other day for a total of 12 injections (3–3.5 mg/kg) were all negative by stool examinations after 3 months. Fifty children receiving 12 injections (1 every other day) at the rate of 3–3.7 mg/kg of body weight also became negative as noted 3 months after treatment. There was 1 adult who was injected 6 times (every other day) that remained positive.

Side reactions were pronounced in the case of adults, equalling those of Stibnal and Fuadin, but for children there was almost no reaction.

From the above mentioned observations, it is concluded that Triostam is an effective drug against schistosomiasis japonica, but that it is accompanied with side reactions peculiar to antimonyl drug compounds.

61. **Composition of the Haptoral Armament and Copulatory Complex of *Urocleidus ferox* Mueller, 1934.** J. E. BERRY AND J. D. MIZELLE, University of Notre Dame.

Chitin tests of Campbell (Integ. Arthropods, U. Minn. Press, 1951) and Bethe (Microtomist's Formulary & Guide, Blakiston, 1954) on the haptoral armament, cirrus, and accessory piece were negative. Semichon's test for chitin (Microtomist's Formulary & Guide) gave a positive reaction for the accessory piece, bars, hooks, and base of the anchors; shafts and points of the anchors were negative. Semichon's positive test for chitin is considered doubtful since the accessory piece, bars, hooks, and base of the anchors were nonbirefringent. Chitin is known to be birefringent (Integ. Arthropods). In a test for saccharides, specimens were treated with Schiff's reagent (Stain Tech. **13:** 123–124) with negative results. The accessory piece, bars, interior of the hooks, and base of the anchors reacted positively when treated with Millon's reagent (Anat. Rec. **57:** 217–233) for proteins, specifically those containing tyrosine. The anchor shafts and points gave a positive reaction in Berg's ninhydrin (Micros. Histochem., Chicago Press, 1952) for free alpha amino acids of proteins. It thus appears that the accessory piece, bars, interior of the hooks and the base of the anchors are proteins which contain tyrosine. The anchor shafts and points appear to be composed of proteins which lack tyrosine. The cirrus reacted negatively to all the above tests.

62. **Monogenetic Trematodes of the Gulf of Mexico.** RAYMOND A. WOOD, Pan American College, Edinburg, Texas.

(No abstract submitted)

63. **Embryonic Development and Morphology of Onchospheres of the Tapeworm *Oochoristica symmetrica* (Cyclophyllidea: Linstowidae).** R. E. OGREN, Ursinus College, Collegeville, Pa.

Oocytes, containing small masses of vitelline substance, underwent meiosis in the uterus. Zygotes divided into 2 nearly equal blastomeres. One blastomere divided more slowly and its cells remained outside the embryo taking no part in forming its structure. The other blastomere divided into small cells of the morula which differentiated into the cells of the hexacanth embryo. The epidermis of the morula, considered homologous to the embryophore of other cestodes, remained as the epidermis of the onchosphere. Hook blades were secreted by granular epidermal onchoblasts. Granular embryonic cells formed the parenchyma. Plastin cells were not numerous until the onchosphere was present in the beetle hemocoel. Certain epidermal cells differentiated into prominent granule-filled glands giving an alkaline reaction. The granules, protein in nature, were associated with cuticle and membrane formation. The hypothesis is presented that glands of this kind in onchospheres are homologous with epidermal and mesenchymal gland cells of Turbellaria. In their final condition the granules gave a positive reaction for glycoprotein with the periodic-acid-Schiff procedure. Early stages of the glands colored blue-green with toluidine blue, and red with van Gieson's. In older onchospheres the gland area spread by the differentiation of other cells near by, thus forming an extensive C-shaped granular area over the presumptive scolex region. Differen-

tiation in the metacestode stage was followed up to the development of flame cells. The granular areas disappeared after 7–15 days in the beetle. The metacestode was composed of compact germinative cells. In the cysticercoid, subcuticular cells developed typical bands of muscle beneath the cuticle by the fusion of cell processes. *Oochoristica* and certain allied cestodes may represent a third type of developmental pattern and another type of onchosphere among the Cyclophyllidea.

64. **The Effect of Different Temperatures on the Development of *Hymenolepis diminuta* (Cestoda: Cyclophyllidea) in *Tribolium confusum*.** M. Voge and J. A. Turner, University of California, Los Angeles.

Beetles infected with *Hymenolepis diminuta* were kept at temperatures ranging from 10–40° C. Development of cysticercoids was successful at temperatures ranging from 15–37° C. A marked increase in the rate of development occurs with increase in temperature. Mature cysticercoids are obtained in 65 days at 15° C, and in 5 days at 37° C. Structural abnormalities may be observed at 37° C, but not at lower temperatures, unless large numbers of larvae are present in one beetle. At 40° C, only abnormal stages were seen. At 10° C, the beetles die before development can be completed.

64a. *In vitro* **Study of *Hymenolepis nana* Rabbit Antiserum against Eggs, Cysticercoids, and Adult Stages of that Parasite.** D. Heyneman and J. F. Welsh, University of California, Los Angeles.

The effects of rabbit antiserum on living *Hymenolepis nana* adult worms, eggs and cysticercoid larvae developed in *Tribolium* beetles have been observed. The rabbits were immunized intraperitoneally with saline dilutions of adult worm homogenates, and were bled 2 weeks after the final injection. The serums were frozen and rendered sterile at the time of testing by the addition of streptomycin and penicillin.

Adult *Hymenolepis nana* in the homologous antiserum showed an immediate marked activation and contraction accompanied by withdrawal of the rostellum in contrast with pronounced flaccidity of worms in normal rabbit serum. After 6–14 hours a marked precipitation on experimental worms was observed first around scolex and neck, and in some cases, eventually covering the entire worm. The metabolically active anterior ends were first and most significantly affected. Eggs were discharged into the serum and were observed to agglutinate. Control worms showed none of these reactions. Eggs tested separately in antiserum showed several reactions including a tendency to agglutinate, an apparent withdrawal of the inner colloidal shell material from the oncosphere, a variable degree of granulation and a pronounced reduction in viability (3.9% of control eggs fed to clean mice recovered as adult worms, *vs* 0.18% of eggs treated in antiserum recovered as adult worms). No such viability effect was noted in initial tests of cysticercoids so treated, although loss of motility of the scolex and extreme eversion of the rostellum was observed in the cysticercoids placed in homologous antiserum.

65. **Carbohydrate Quantity and Quality: Its Significance in the Biology of Tapeworms.** C. P. Read and A. H. Rothman, The Johns Hopkins University.

Other work in this laboratory indicated that the rat tapeworm, *Hymenolepis diminuta*, is sharply limited in the spectrum of carbohydrates utilized. In the experiments to be reported the rat host was placed on high carbohydrate diets during the period of worm development. Some effects on the worm of glucose, sucrose, maltose-dextrins, and starch, in each case as sole dietary carbohydrate, have been determined. All animals harbored a single worm. At autopsy of 8- to 10-week-old Wistar males 18 days after infection the mean wet weights (grams) of worms on the several dietary regimes were: (1) starch—0.865 ± 0.046; glucose—0.478 ± 0.0061, (2) starch—0.734; sucrose—0.174, and (3) starch—0.686; maltose-dextrins 0.031. Except for maltose-dextrin diets, similar results were obtained with animals infected for 4–6 months and placed on the experimental diets for 14 days before killing. Older animals on the maltose-dextrin diet had worms of about the same weight as animals on the sucrose diet. Data on effects of the diet on egg production and morphology are presented. Some of the above findings are related to new experimental data on the rate of glycogenesis *in vivo* and *in vitro*.

The experimental findings are discussed in terms of (1) the physiology of carbohydrate digestion and absorption by the host, (2) extrapolation of experimental findings *in vitro* to the biology of the worm, (3) the unique character of a biological requirement for carbohydrate by cestodes.

66. **Survival of *Chorioptes bovis* (Gerlach) on Epidermic Debris and Hair from Various Mammals Under *In Vitro* Conditions.** GORDON K. SWEATMAN, Animal Pathology Division, Canada Department of Agriculture, Montreal Area Branch Laboratory, Macdonald College, Quebec, in cooperation with the Institute of Parasitology.

Ovigerous females lay their eggs in communal groups in culture vials of mites maintained on epidermic debris and hair from cattle under conditions of 35° C, 80% R.H. and complete darkness. Eggs from this source were transferred to other vials containing debris and hair from various mammals for determination of the survival of subsequent stages in the life cycle.

Students recognize 5 species of chorioptic mites; each declared to be host specific to either cattle, horses, goats, sheep or rabbits. In this study, *C. bovis* from Holstein-Friesian (Quebec) and/or from Shorthorn (Illinois) completed the life cycle *in vitro* on another taurine species (Brahman) as well as various cattle breeds in the usual 3-week period. Two cycles of *C. bovis* were completed on material from horses and goats, and then successfully returned to cattle debris for the third generation. Each cycle spanned the standard period without any indication of sterility or apparent loss of vigor. Mites from naturally infested horses displayed similar results when on epidermic debris and hair from cattle for the first 2 generations. *C. bovis* was not sustained on sheep *wool* (Suffolk), or on hair and debris from dog, cat, swine, man and dromedary. Larvae and nymphs, with only occasional development into subsequent stages, were maintained generally for prolonged periods on epidermic material from bison, donkey, white-tailed deer, rabbit and guinea pig. Some survival of *C. bovis* is possible, therefore, on material from many mammals, and material from some sources prolongs the developmental stages.

67. **Studies on the Feeding Habits of Three Species of Laelaptid Mites.** G. W. WHARTON AND HANSELL F. CROSS, University of Maryland and Northeastern Louisiana State College.

Feeding habits of 3 species of laelaptid mites, *Laelaps nuttali*, Hirst, 1915; *Laelaps echidninus* Berlese, 1887; and *Haemolaelaps glasgowi* (Ewing, 1925), were studied to determine the possibility of these mites being vectors of disease to man. Laboratory-reared mites were allowed to feed either on the skin of the host after the method of Cross and Wharton (1954) or on various mixtures of blood and blood fractions through a bolting silk membrane after the method of Cross (1954). All 3 species of mites fed readily on the whole blood of bird and rodent as well as on the blood fractions, but no definite preference for a particular kind of blood or blood fraction was noted. None was seen to feed through the undamaged skin of rat, chick or human, but all 3 species fed readily on abraded human skin by inserting their mouthparts into the dermis. Temperature appeared to have a marked effect on feeding, its effect being different for each species. More mites fed at low relative humidity (22%) at 85° F than at higher humidities, though no significant differences between low and high R.H. were found. Since the laelaptid mites have been demonstrated to feed as readily on abraded skin of the human as on that of the rat, they should not be overlooked as possible vectors of disease to man.

(This investigation was supported by the Medical Research and Development Board, Office of the Surgeon General, Department of the Army, under Contract No. DA-49-007-MD-501.)

68. **Observations on the Nasal Mite Genus *Sternostoma* Berlese and Trouessart (Acarina: Rhenonyssidae).** DEANE P. FURMAN, Department of Entomology and Parasitology, University of California, Berkeley.

The genus *Sternostoma* Berlese and Trouessart, 1889, is composed of mites primarily parasitic in the nasal cavities of birds. As the name implies members of this genus have the mouth parts ventrally located, only the tips being visible from the dorsal side. Several other distinctive features occur in the group, such as reduction and modification of the claws of tarsus I, and minute size of the cheliceral digits. The significance of these differential features is minimized by those workers who have considered *Sternostoma* as indistinguishable from *Rhinonyssus* Trouessart, 1894; the latter genus is distinct on the basis of each of the characteristics mentioned above. The question of the status of *Sternostoma* has been complicated further by the fact that Trouessart (1895) proposed the name *Sternostomum* as an emendation of the earlier *Sternostoma*. Although *Sternostomum* is a synonym it has been used by several recent workers to separate species of this complex having a single dorsal plate instead of the usual 2 dorsal plates. This viewpoint is untenable on both nomenclatorial

and zoological grounds. The dorsal plates of these mites are obviously in the process of disappearing and the character is too unstable for use as a generic guide.

The hosts of the 9 known species of *Sternostoma* belong to the Charadiiformes and Passeriformes. Although we are in an early stage of knowledge concerning distribution of these parasites some correlations appear significant, particularly at the family level of hosts.

69. **Pentastomids from African Reptiles and Mammals and from Reptiles of Florida Island, British Solomon Islands (South Pacific).** J. TEAGUE SELF, The University of Oklahoma AND ROBERT E. KUNTZ, Naval Medical School, NNMC.

This paper deals with collections of Pentastomida from reptiles taken on the British Solomon Islands and from reptiles and mammals taken from the Anglo-Egyptian Sudan and Egypt.

Three genera and 5 species of Pentastomida are reported from African reptiles and 1 genus and 1 species is reported from African mammals.

Six genera and 5 species of previously described Pentastomida are reported from reptiles from the British Solomon Islands. In addition to these *Megadrepanoides* n. gen. and *M. solomonensis* n. sp. and *M. varani* are described from *Varanus indicus* the B.S.I. monotor lizard.

In addition to the new species descriptions, 15 new host records are reported.

This work is based on extensive field collections of Pentastomida some of which initiate further concern regarding the validity of the numerous species of *Raillietiella* reported.

70. **Surface-wintering of Aquatic Snails in Central Washington.** C. W. MCNEIL AND W. M. WALTER, State College of Washington.

Stagnicola palustris nuttalliana and *Fossaria perplexa*, collected from the moist surface of canal banks during March, April and May 1956, became active when placed in water at room temperatures. Most of these snails had well-formed epiphragms and appeared to have survived the winter without burrowing or otherwise seeking shelter. Both species withstood experimental temperatures of 23° F for 24 hours.

The Moses Lake Weather Bureau station, located in the study area, supplied pertinent data. For the 5 months October–February, the mean of the average temperature was 30° F, 6 degrees colder than the equivalent means of the preceding 3 winters. Except for natural precipitation, the canals were dry from October 1955 to April 1956. During that time records showed 12 periods, totaling 55 days, in which the maximum temperature was 32° F or less. The lowest temperature was −17° F, recorded when snow depth was 3 inches.

(This investigation was supported in part by research grant E900 from the National Institute of Allergy and Infectious Diseases, National Institutes of Health, Public Health Service.)

71. **Studies on the Biological Control of Schistosome-bearing Snails: a Preliminary Report on Pathogenic Microorganisms Found in *Australorbis glabratus*.** CHIA-TUNG PAN, Harvard School of Public Health, Harvard University.

During the course of studies on the histology of *Australorbis glabratus* 2 types of microorganisms which caused both pathological changes and possibly some mortality were discovered.

One of the organisms is an acid-fast bacillus-like rod found in 3 of 22 snails sectioned serially. It appears to be an obligate intracellular organism and has always been found clumped in amoebocytes, some of which may resemble lepra globi. The tissue reaction induced by this organism results in the aggregation of the parasitized amoebocytes and their subsequent walling-off by fibroblasts. No necrosis was observed in the infected snails. The rectum ridge, kidney, gut, mantle, foot and ovitestis were affected.

The second organism is a fungus spore- or yeast-like agent which invades various tissues but particularly those of the nervous system. It has been found in 5 of 22 snails sectioned. In addition to a tissue response similar to that caused by the acid-fast rods, this organism also provokes considerable hyperplasia of the amoebocytes. The ganglion cells and neurofibrils of the central nervous system are attacked and replaced by amoebocytes which phagocytize many of the organisms. Mycelial growth in the loose vascular connective tissue was also observed in the infected snails.

Efforts are in progress to isolate these organisms in culture for further study.

72. **The Role of Documentation in Parasitological Research.** MILDRED A. DOSS, Animal Disease and Parasite Research Branch, ARS, U.S.D.A. Research Center, Beltsville, Maryland.

Good research can only be built upon the foundations laid by previous workers. Without a knowledge of what has gone before, the scientist cannot know how to avoid duplication of effort, where to begin his investigations, how to plan his work, and how to evaluate it. Parasitology presents an especially difficult problem since the field has steadily grown in extent and importance, with a corresponding growth in the literature, widely scattered throughout many branches of science, many languages, and many types of publications. The Zoological Division of the former Bureau of Animal Industry recognized this problem and initiated measures to solve it when, in 1892, Albert Hassall founded the Index-Catalogue of Medical and Veterinary Zoology. This working tool of the Division, now represented by 3 parasite Sections, forms one of the most complete, detailed and discriminating indices of any field of science.

Four indices are maintained: Author, Parasite, Host, and Treatment, plus a Checklist of Specific and Subspecific Names, which records changes in nomenclature. Fifteen thousand serial publications from 202 libraries, domestic and foreign, public and private, have been and are being examined. Thirty-two languages are represented. All available literature in animal parasitology and in plant and free-living nematology is indexed in depth, systematic papers being thoroughly analyzed. Only the Author Catalogue is now well known, having been published in 2 editions and 5 supplements. Supplements 6 and 7, representing current literature, are in press. Three Subject, or Parasite, Catalogues have been published—the Trematoda (1908), the Cestoda (1912), and the Roundworms (1920). These are now rare books and practically impossible to obtain. This enormous accumulation of information of interest to parasitologists is in manuscript form in the Animal Parasites Laboratory of the Agricultural Research Service at Beltsville, Md.

73. **Acquired Immunity in Lambs Infected With *Taenia hydatigena* Pallas, 1766.** GORDON K. SWEATMAN, Animal Pathology Division, Canada Department of Agriculture, Montreal Area Branch Laboratory, Macdonald College, Quebec, in cooperation with the Institute of Parasitology.

Each experimental animal received an initial dose of 50 to 800 eggs when it was 3 months old. A challenging dose of 5000 eggs followed in 7 weeks. Control animals received only the latter dose, and all animals were examined 3 weeks later. Recent haemorrhagic streaks throughout the liver parenchyma, open pits in Glisson's capsule, and small cysticerci in the abdominal fluid and elsewhere were known from a previous study to occur in 3-week infections. These occurred in the controls, whereas the experimental group displayed repaired hepatic lesions together with omental and mesenteric cysticerci containing fully developed rostellar hooks; indicative only of the initial dose. Resistance to superinfection was similar in each experimental lamb, even though some initial doses contained as few as 50 eggs.

74. **The Distribution of Succinic Dehydrogenase Activity in *Hymenolepis diminuta* and *Raillietina cesticillus*.** R. M. HEDRICK, The Rice Institute.

The distribution of succinic dehydrogenase activity, demonstrated by the reduction of neotetrazolium chloride to a water-insoluble blue dye, was similar in both *Raillietina cesticillus* and *Hymenolepis diminuta*. Intracellularly, the staining reaction occurred as small rods and spheres, suggesting mitochondria. The largest concentrations occurred in the cortical and subcuticular regions of the worms, decreasing posteriorly until, in the gravid region, only the subcuticular layer showed a concentration of activity. Heavy concentrations also occurred in the developing testes and ovary. At maturity, only the testes of *Raillietina* and the ovary of *Hymenolepis* stained intensely. However, a few cells of the testes of *Hymenolepis* stained in mature and older proglottids. Also, the vitellarium, the osmoregulatory canals, particularly the ventral pair, and the walls of the male and female sperm tracts, excepting the cirrus, showed slightly more enzyme activity than the surrounding parenchyma. In the gravid regions, occasional heavy concentrations of activity bordered the uterus of *Hymenolepis* and the parenchymatous pouches of *Raillietina*. The eggs of both species showed considerable enzyme activity in the membrane just beneath the egg-shell. In the absence of succinate in the incubation medium almost no activity could be demonstrated microscopically. However, the addition of malonate to the fortified medium did not significantly diminish the staining reaction of the tapeworm tissues and malonate alone did not support the reaction.

75. **New Records of the Occurrence of the Hydatid Tapeworm, *Echinococcus granulosus*, in Central and South Mississippi.** J. W. WARD, University of Mississippi Medical Center AND R. C. BRADSHAW, Jackson Packing Company.

The livers of 8,066 hogs from south and central Mississippi were examined for the unilocular type of the hydatid stage of *Echinococcus granulosus*. The majority of the animals were less than 2 years of age. They were shipped from 5 different areas of south and central Mississippi to the Jackson Packing Company where they were processed. These animals were slaughtered and examined between September 1, 1955, and May 1, 1956. These examinations revealed that 348, or 4.03% of the hogs were infected with the unilocular type of *Echinococcus granulosus* cyst. The cysts measured from 4 to 65 mm in diameter. Three percent of them were double, 2% were triple. Seven percent were sterile. In addition to the hogs examined from Mississippi, 1157 animals that had been shipped from St. Louis, Missouri, were examined. No hydatid cysts were recovered.

Records have been made available from the examinations of the livers of 800 cattle from areas of south and central Mississippi. Of this number, slightly more than 1% were infected with the unilocular type of *Echinococcus granulosus* cyst.

Examinations of the intetsines of 65 dogs from the Jackson area revealed that 1 animal harbored the adult stage of *Echinococcus granulosus*.

76. **Polysaccharide Metabolism in Cestodes and Acanthocephala.** C. P. READ AND A. H. ROTHMAN, The Johns Hopkins University.

Glycogen metabolism has been studied in *Hymenolepis diminuta, H. citelli,* and *Moniliformis dubius*. Male Wistar rats, infected with 4 *H. dimnuta* each, were starved for 24 hours and given 1.0 gram of starch by stomach tube. They were killed in groups of 6 at intervals of 4, 24, and 48 hours after receiving starch. All worms were weighed and washed for 40 minutes in Ringer's solution at 38° C. One half the worms from each host were used to determine initial polysaccharide. Each of the remaining worms was incubated in 5.0 ml Krebs-Ringer bicarbonate containing 10 mg of glucose. After 60 minutes the worms were removed for glycogen determination and the medium analyzed to determine glucose utilization. Mean values for glycogenesis (mg glycogen per 100 mg wet tissue) were: (4 hours) + 0.63, (24 hours) + 0.66, and (48 hours) + 1.62. Mean values for glucose utilization (mg glucose per 100 mg tissue) were: (4 hours) 2.30, (24 hours) 2.46 and, (48 hours) 4.43. However, as starvation proceeds the worms become smaller so that the total glucose utilized per worm remains more nearly constant. Average glucose utilization (mg) per worm was (4 hours) 9.64, (24 hours) 8.68, and (48 hours) 7.61. The starved worms show a higher efficiency for polysaccharide storage; the ratios of glycogen synthesis to glucose utilization were: (4 hours) .273, (24 hours) .268, and (48 hours) .365.

Similar data have been obtained with *H. citelli* and *M. dubius*. Quantitatively, the above data on *H. diminuta* fail to agree with those recently reported by Daugherty (J. Parasitol. **42:** 17). However, Daugherty used a different strain of host rats and a markedly hypertonic incubation medium in his experiments. Since we have found that worms from unstarved hamsters and Wistar rats on the same diet differ in polysaccharide content by about 100%, the differences in results of various investigations are not surprising.

77. **The Active Absorption of Methionine by Cestodes.** JACK W. DAUGHERTY, The Rice Institute.

Hymenolepis diminuta (rat) and *Raillietina cesticillus* (chicken) were incubated for varying lengths of time at 4° C and at 38° C in Krebs-Ringer Phosphate medium to which was added 9.5 microcuries of S^{35}-labelled methionine (*ca.* 43 micrograms). The worms were then washed, weighed, stretched on filter paper, and divided into linear sections. Equal samples from each section were wet-ashed and their radioactivity determined. There was always higher activity in the anterior region, and frequently in the gravid region, than in the mature region. The uptake at 38° was 300–400% higher than at 4° C. This exceeds the theoretical effect of a similar temperature change on the rate of simple diffusion (about 100%). This was substantiated by studies on the uptake of $Na^{22}Cl$ by cestodes and S^{35} methionine by rat diaphragm. In both cases the anticipated effect of a 34° elevation in temperature on diffusion rates was obtained (25–30% increase for each 10°). KCN, CO, and anaerobiosis were ineffective in altering the rate of uptake. The addition of pyruvic acid, oxalacetic acid, and alpha-ketoglutaric acid materially increased the absorption of methionine by the cestodes. This effect was not found when the incubation was carried out at 4°. These results are consistent with the proposal that there is an active (metabolic) transport of methionine across the integument of the cestode.

78. **Effect of Lindane on the Hatchability of the Eggs of** *Chorioptes bovis* **(Gerlach).** GORDON K. SWEATMAN, Animal Pathology Division, Canada Department of Agriculture, Montreal Area Branch Laboratory, Macdonald College, Quebec, in cooperation with the Institute of Parasitology.

Lindane (0.046%) is used routinely in Canada for the treatment of chorioptic mange. Eradication of the mite, however, is not always effected. One possible reason lies in the resistance of some stage in the life cycle to the effects of the drug. With this in mind, observations were made on the hatchability of eggs of *C. bovis* on filter paper made wet with lindane and maintained *in vitro* under complete darkness at 35° C and 80% R.H. Controls consisted of: (a) eggs on dry filter paper, and (b) eggs on filter paper made wet with water. Water alone apparently prevented the hatching of 5 eggs, but all (251) other control eggs hatched. None hatched of the 262 eggs (constituting 20 trials) that were exposed to the drug, showing the effectiveness of the lindane suspension under the above conditions. Additionally, filter paper made wet with lindane was allowed to dry, and then eggs were placed on it. All of these eggs hatched, demonstrating that lindane following drying does not prevent hatching of the eggs.

79. **Blood Parasites in Reptiles.** ROBERT W. HULL, Department of Biological Sciences, Northwestern University, Evanston, Illinois AND JOSEPH H. CAMIN, Chicago Academy of Sciences, Chicago, Illinois.

Surveys of snakes at Lincoln Park Zoo, Chicago, Illinois, have demonstrated a consistently high rate of infection with *Haemogregarina* sp. and 2 instances of microfilarial infection. Survey of the reptile collection in 1955 showed an infection rate of 42.4%; one year later, the rate was 23.1% in the same captive population. In the intervening year, zoo personnel had taken measures to reduce mite populations in the reptile cages since there is evidence that the haemogregarines are transmitted by the blood-feeding mite, *Ophionyssus natricis*. To determine if blood parasite incidence is increased by captivity, snakes sent to the zoo immediately upon capture were examined before they had been exposed to the zoo's mite population. The infection rate of these specimens was 75.0% among the king snakes (*Lampropeltis*) and other constrictors, while only 21.3% among coachwhip snakes (*Masticophis*) and other non-constrictors. The overall infection rate in the snakes from the wild was 35.8%. The differential infection rate in the 2 groups in nature may be related either to host preference or to differences in feeding habits of the 2 groups. King snakes and allied forms constrict their prey before ingesting it and thus may be expected to ingest more mites rubbed off the body and onto the prey than do non-constrictors. Careful comparison of the blood stages of the haemogregarines from infections in any genus of snake gives no evidence of distinct species of haemogregarines. Experimental transmission of the parasite from one genus of snake to another is under way at present. The 2 infections with microfilariae are also apparently of the same parasite species.

80. **"Stepping Stones in the History of A.S.P."** ELOISE B. CRAM, National Institutes of Health, Bethesda, Maryland. **Presidential Address.**

81. **Some Stages in the Life Cycle of** *Nematospiroides dubius* **Baylis, 1926 (Nematoda: Heligmosomidae).** JOHN H. CROSS, JR. AND J. ALLEN SCOTT, University of Texas Medical Branch at Galveston.

The demonstration will show some stages in the life cycle of *Nematospiroides dubius* from the laboratory mouse and in comparison similar stages from the white rat.

(This work was supported by National Science Foundation Grant 1213.)

82. **An Electron Microscope Study of** *Plasmodium lophurae*. MARIA A. RUDZINSKA AND WILLIAM TRAGER, The Rockefeller Institute for Medical Research, New York, New York.

An examination of many thin sections of duck erythrocytes infected with *Plasmodium lophurae* disclosed that the parasite is located within the cytoplasm of the host cell. In no instance does it enter the nucleus. The parasite is easy to identify because of the low density of its cytoplasm contrasted to the very dense cytoplasm of the red cell.

The fine structure of *Plasmodium lophurae* reveals the presence of all major components found in animal cells, although some of them are poorly represented. The body is covered by a thin plasma membrane which is closely adjacent to the cytoplasm of the host. The most prominent feature is the appearance of very dense bodies which may be divided into 2 groups: a) Large (over 0.5 micron in diameter) spherical bodies, probably lipid; b) smaller (about

170 millimicrons in diameter) elongated granules representing pigment assembled in the ovoid residual body (almost 1 micron in shorter diameter). The matrix of the residual body is homogenous and limited by a thin membrane. Small numbers of typical mitochondria are present, as well as some larger structures which might be swollen mitochondria or vacuoles. The endoplasmic reticulum is poorly represented. Small particles about 150 A in size are scattered throughout the cytoplasm. The nucleus (in later stages 3 to 4 may be found in sections) is much denser than the cytoplasm and is composed of very fine fibrils forming a spongework. In some nuclei a denser body of the same spongelike structure is present. Around the nucleus is a double membrane which in places shows pores.

Some observations were made also on the fine structure of the host erythrocytes. The mitochondria have a double membrane and their internal structure is composed of cristae mitochondriales as described by Palade for mammalian cells. The endoplasmic reticulum appears in the form of vesicles. The nucleus is surrounded by a double membrane and the matrix shows a dense fine fibrillar structure. In some nuclei denser elongated irregular bodies may be found.

[Supported by a grant from the National Heart Institute USPHS H1350 (C3).]

83. **Susceptibility of Domestic Animals to Infection with *Trypanosoma cruzi* from the Raccoon.** L. S. Diamond and R. Rubin, USDA, Beltsville, Maryland. (Presented by demonstration as well as read).

(See Abstract #31)

84. **A New Digenetic Trematode from the Muskellunge, *Esox m. masquinongy*.** Jacob H. Fischthal, Harpur College, State University of New York.

During a parasite survey of northwestern Wisconsin fishes 12 worms were recovered from the small intestine of one *Esox m. masquinongy* collected on August 1, 1945 from Teal Lake, Sawyer County, Wisconsin. The study of whole mounts and serial cross and frontal sections indicated that a new genus and species of uncertain familial relationship is represented.

85. **Studies on the Genus *Plagitura* Holl, 1928 (Trematoda: Plagiorchiidae).** Frank J. Etges and M. E. Patzer, University of Cincinnati.

Specimens of *Plagitura* considerably larger than either *Plagitura parva* or *P. salamandra* were found in a number of specimens of *Triturus viridescens* collected in Bear Lake, Scioto County, Ohio. Individuals identified as *P. parva* and *P. salamandra* have also been found in the same species of salamander collected in the same and other nearby areas. In general arrangement of organs, the large specimens are more similar to *P. parva*, the smaller of the 2 known species, but in overall body size the present specimens are 3 to 4 times larger than the maximum size reported for *P. parva*. Immature specimens with very few or no eggs in the uterus have been found which are larger than fully mature and gravid specimens of *P. parva* and *P. salamandra*. Preliminary evidence indicates seasonal differences between the 3 forms of *Plagitura* being studied, with respect to their occurrence as mature adults in *Triturus*. Further studies on the morphology and life history of the present large specimens are being carried on to determine whether they are different from the 2 described species, or merely a variation of 1 of them.

86. **Hepatitis Due to *Amphimerus pseudofelineus* in a Cat.** Norman D. Levine, Paul D. Beamer and Dragutin Maksic, University of Illinois.

A 10-year-old cat was submitted to the University of Illinois Veterinary Clinic in March, 1956 with symptoms of incoordination, blindness and hepatitis. It died the next day. At autopsy the liver was found to be extremely degenerate, with fatty changes and chronic passive congestion. The bile ducts were distended, and contained many *Amphimerus pseudofelineus*. On histopathologic examination of the liver, periportal cirrhosis, proliferation of the bile ducts, and centrolobular fatty changes were found.

87. **Concerning the Early Developmental Stages of *Ornithobilharzia canaliculata* (Rudolphi, 1819).** Lawrence R. Penner and Alvin Wagner, University of Connecticut, Storrs.

Difficulties involved in obtaining eggs and miracidia of avian schistosomes which could definitely be assigned to adults collected from natural hosts, led us to infect numerous laboratory birds in order to find suitable hosts for recovery of eggs and miracida. The fresh feces

of infected pigeons proved most suitable of exposed hosts infected for study of *Ornithobilharzia canaliculata* (Rudolphi, 1819), found naturally in the Royal Tern. Eggs appear in about a month in feces, associated with bloody exudate in severe and fatal cases. They average approximately 100 by 80 microns and usually bear an egg spine which averages 15 microns long.

Miracidia average 150 by 35 microns when fully extended. There are usually 22 dermal cells arranged in 4 tiers of 6, 9, 4, and 3 respectively. Germ cells lie within a very thin membrane; they range in numbers between 18 and 26. Mother sporocysts have not been recovered in exposures of juvenile *Batillaria minima* (Gmelin), but relatively short branched daughter sporocysts with developing cercariae have been studied from naturally infected snails. Larval stages of *O. canaliculata* relate it more closely to members of the genus *Austrobilharzia* where larval stages are known and efforts are being made to determine the relationships between avian and mammalian species previously placed in the genus *Ornithobilharzia*.

(This investigation was supported in part by research grant E-740 from the National Institutes of Health, Public Health Service.)

88. **Studies on the Biology of Marine Acquired Avian Schistosomiasis.** LAWRENCE R. PENNER, University of Connecticut, Storrs.

Certain species of marine snails which serve as hosts for dermatitis-producing schistosome cercariae require a rather close association with their avian hosts for the development of a high incidence of infection.

Special attention has been paid to the relation which exists between *Batillaria minima*, the marine snail host of *Ornithobilharzia canaliculata*, and Royal, Caspian, and other large terns which visit sandy spits of land along the Gulf Coast of Florida. Snail infection incidence exhibits 2 seasonal peaks which are regulated in part by visitations of the birds involved and by the age of the snail host. Marked snail returns have been helpful in determining the time when infections are acquired in areas of highest incidence.

Observations have also been made concerning the relationship between *Nassarius obsoletus*, snail host of *Austrobilharzia variglandis*, and numerous species of migrant waterfowl involved.

Special rapid snail examination equipment has been developed including aluminum trays to hold snail racks with plain, 15-hole, or single-slit bottom racks to facilitate determination of cercarial incidence. This enables speedier determination of important dermatitis areas. The single-slit bottom rack is preferable for infections requiring microscopic equipment.

The histopathology of avian schistosomiasis has been investigated in laboratory- and naturally collected infected birds for several marine acquired species, including *Ornithobilharzia canaliculata*, *Austrobilharzia variglandis*, and *A. littorinalinae*, and is in fairly close agreement with the histopathology produced by mammalian species.

(This investigation was supported in part by research grant E-740 from the National Institutes of Health, Public Health Service.)

89. **The Life-History of *Macroderoides spiniferus* Pearse, 1924, a Trematode of the Florida Spotted Gar, *Lepisosteus platyrhincus*.** W. H. LEIGH, University of Miami.

The gar of South Florida, *Lepisosteus platyrhincus*, are infected with only 2 intestinal trematodes, *Paramacroderoides echinus* Venard, 1941 and *Macroderoides spiniferus* Pearse, 1924. Both species use the same molluscs and fishes as intermediate hosts.

Sporocysts of *M. spiniferus* develop in the pulmonate gastropod *Helisoma duryi* (Wetherby) and produce xiphidiocercariae belonging to the group Cercariae Armatae. Cercariae penetrate and encyst in the muscle tissue of several species of small fishes, the most numerous being *Gambusia affinis holbrooki* Girard. The metacercarial stage undergoes a marked transformation and becomes infective for gar in approximately 14 days. After ingestion by the final host, sexual maturity is achieved and infective eggs liberated in 12 days at summer temperatures. Eggs are embryonated when deposited and hatch only after ingestion by the snail host.

Thirty-one of 72 gar examined in 1955 and 1956 were infected. Infections varied from 1 to 40 trematodes. Since Pearse (1925) described *M. spiniferus* from the short-nose gar, *Lepisosteus platostomus*, it has been reported from the long-nose gar, *L. osseus* by Simer (1929) and from *L. platyrhincus* and the brown bullhead, *Ameiurus nebulosus marmoratus* in Florida by Bangham (1941).

90. **Observations on Life-Histories of Members of the Genus *Ascocotyle* Looss (Heterophyidae).** W. H. LEIGH, University of Miami.

Small fishes of South Florida serve as hosts for metacercariae of 3 species of the heterophyid genus *Ascocotyle* Looss which at present contains 7 species of intestinal trematodes reported from piscivorous birds.

The metacercaria of one species occurs within extremely thick-walled cysts attached to mesenteries and viscera of *Gambusia affinis holbrooki* Girard, and *Mollienesia latipinna* LeSueur. This form has been successfully reared to sexual maturity in day-old chicks and has been identified as *A. mcintoshi* Price, 1936, described from *Guara alba* from Florida. Metacercariae of 2 other species were found restricted to the conus arteriosus of their fish hosts. They possess thin-walled cysts and occur under the endothelial lining where they extend into and obstruct the lumen of the conus. One species, host specific for *M. latipinna*, has been reared in chicks and found to constitute a previously undescribed species which will be described by Burton. The other species is less specific; it occurs principally in *Gambusia* but appears occasionally in *Mollienesia* and *Chaenobryttus coronarius* (Bartram). Specimens derived from infected chicks have been identified as *A. tenuicollis* Price, 1935, described from *Botaurus lentiginosus*. Locally, this species has been recovered from *Florida caerulea caerulea* and *Hydranassa tricolor ruficollis*.

91. **Development of *Cotylurus flabelliformis* Tetracotyles in the Second Intermediate Host (Trematoda: Strigeidae).** M. J. ULMER, Iowa State College.

Lymnaea reflexa serves as the normal intermediate host for the duck trematode, *Cotylurus flabelliformis* in the vicinity of the Iowa Lakeside Laboratory at Lake Okoboji, Iowa. The development of the metacercariae (tetracotyle) within the ovotestis of the snail host has been followed in both natural and experimental infections. Twenty-four hours after penetration of cercariae, the actively moving young worms have increased little in size, but internal morphology is much less distinct. Six to 15 days after penetration, developing metacercariae have enlarged enormously, some specimens measuring more than a millimeter in length. Still actively motile at this stage, the greatly vacuolated metacercariae are characterized by a network of stellate-shaped cells, with clumps of refractile granules scattered throughout the parenchyma. Little trace of oral sucker, acetabulum or digestive tract may be noted. Reorganization of internal organs now commences and the typical encysted tetracotyle form is gradually assumed. Pre-cysts, less motile than the large developing stages, are of 2 types: An earlier elongate one exhibiting preliminary differentiation of fore- and hind-body, and a later one characterized by conspicuous lateral cotyle, cup-shaped forebody and prominent holdfast. Fully formed encysted tetracotyles appear within 20 to 30 days in experimental infections maintained at room temperature during summer months.

92. **Further Studies on *Hysteromorpha triloba*, and Some Parasites of a White Pelican.** E. J. HUGGHINS, South Dakota State College. (Presented by demonstration as well as read.)

(See Abstract #50)

93. **The Pathology and Pathogenesis of Fatal Infections Due to an Acanthocephalid Parasite of Marmoset Monkeys.** LYELL J. THOMAS, University of Illinois AND MICHAEL J. TAKOS, Dept. of Pathological Anatomy, Gorgas Hospital, Ancon, Canal Zone.

Four of 10 golden-marmoset monkeys, *Saimiri o. orstedii*, from Chiriqui Province, Panama, which were purchased for use as experimental animals, died as a result of naturally acquired infections by the acanthocephalid parasite, *Prosthenorchis elegans* (Diesing, 1851). Generally, the monkeys became sick very suddenly, and died after an illness lasting less than 24 hours. At autopsy, 3 of the 4 monkeys were shown to have perforations of the colon. Acute peritonitis, secondary to such perforation, was present in 3 animals, but the fourth monkey also showed patchy areas of peritonitis even though there was no evidence of perforation. The serosal surface of the bowel of all the infected animals was studded by firm pearly nodules from 2 to 6 mm in diameter. Whenever perforation had occurred, it had taken place through one of the nodules. The serosal nodules lay directly opposite the places where *Prosthenorchis* parasites were attached to the mucosa of the colon.

One infected animal contained 45 of the worms, the others harbored 89, 93, and 110 respectively. Histological sections of the bowel where the worms had tunneled did not show any tissue reaction to the parasites, even when the worms had penetrated through the mucosa, submucosa, and into the muscle layers. The serosal nodules were formed of fibrous bands

and collections of epithelioid-like cells, and apparently were the normal reaction of the host tissues to the presence of the parasites. In sections taken from areas where perforation had occurred, the histology differed. Here masses of polynuclear cells infiltrated the tissues surrounding the tunnels, and extended in sheets from the mucosa to the serosal surface. Bacterial cultures from the peritonitis permitted the isolation of bacteria of the *coli-aerogenes* group. Heart's blood cultures made at autopsy revealed the presence of a septicaemia, due to a baciillus similar to *Escherichia coli.*

Direct damage caused by *Prosthenorchis* was limited to the mechanical effects of penetration of the bowel wall. Apparently, it was only when bacteria, such as are normally present in the colon, gained access to the tissues of the bowel wall beneath the mucosa that an acute purulent inflammation occurred. This bacterial infection was apparently the cause of the perforation which led to acute peritonitis, rather than the mechanical activity of the worms themselves. Thus, secondary bacterial infection of the worm tunnels was the cause immediately responsible for the perforation of the colon. Considering the great numbers of tunnels, and the few areas of acute infection, it seems logical to suppose that these parasites may secrete some substance which prevents the establishment of bacteria within most of the tunnels.

Deaths due to *Prosthenorchis* infection have occurred in various zoological gardens in various primates of the Old World, as well as other mammals.

94. **Some Parasites of the English Sparrow in Maryland.** GRANT I. WILSON, Animal Disease and Parasite Research Branch, ARS, U.S.D.A. Research Center, Beltsville, Maryland.

A total of 55 English sparrows (*Passer domesticus*) was collected in Maryland and examined for parasites over a 2-year period, 1954–1956. The results of this investigation are summarized as follows: ECTOPARASITES—Acarina: *Proctophyllodes pinnatus*—62% infested, on flight feathers, new locality record; *Trouessartia* sp.—1 bird infested, on flight feather, new host record, possibly an accidental infestation of *T. rosteri* from the starling; *Dermoglyphus elongatus*—one bird infested, in quills of pinfeathers, first report of this mite from a wild bird in America; *Harpirhynchus pilirostris*—20% infested, attached to base of lateral head feathers, not previously reported from America; *Syringophilis* sp.—55% infested, in quills of flight feathers, first report of this genus from North American sparrows; *Dermanyssus americanus*—25% infested, on skin or base of feathers; *Dermanyssus gallinae*—one bird infested, the common poultry mite; *Ornithonyssus sylviarum*—one bird infested, the northern fowl mite. *Pellonyssus passeri* (description in press by Clark and Yunker, Proc. Helminth. Soc. Wash.)—one fledgling bird, a nest mite; *Paraneonyssus hirsti*—40% infested, in nasal passages; *Sternostoma cryptorhynchum* (?)—one bird infested, in pleural cavity, a nasal mite of sparrows described from France in 1889 and unreported since. Mallophaga: *Bruelia vulgata*—20% infested, on body feathers. ENDOPARASITES—Protozoa: *Isospora* sp.—95% infected, intestine. Cestoda: *Choanotaenia passerina*—2 birds infected, intestine. Nematoda: *Microtetrameres* sp.—1 bird infected, proventriculus, new host and locality records; *Capillaria sp.*—77% infected, intestine, new host and locality records. Species of particular interest will be demonstrated.

95. **A Comparison of the Genera** *Gyrocoelia* **Fuhrmann, 1899 and** *Infula* **Burt, 1939.** W. H. COIL, Ohio State University.

(No abstract submitted)

96. **Studies on Rodent Echinococcosis.** LYELL J. THOMAS AND BERT B. BABERO, University of Illinois and the Arctic Aeromedical Laboratory.

Echinococcosis is an important health menace to the natives and military personnel of St. Lawrence Island. The form occurring on the island is believed by us to be cospecific with the alveolar type reported from Eurasia. The endemicity of the disease is maintained by voles, dogs, and foxes which reach the island via ice floes or bridges. Evidence accumulated indicates that the disease is already established on the North American mainland.

Experimentally, numerous voles have been successfully infected. The rate of cystic development in white laboratory mice was much slower than in field mice and ground squirrels, although the comparative percentages infected were about equal and the manner of growth was similar. Eggs, in tap water, stored at 2 degrees C for over 2 years were infective to voles. Very old dehydrated fox scats obtained from the tundra contained viable eggs even after 2 years storage.

Immunization studies, using antigens made from extracts of *Taenia* spp., indicates that white mice may possibly be protected in this manner.

97. **Morphological Variations in the Embryonic Hooks of Tapeworms.** J. C. HWANG AND K. C. KATES, Animal Disease and Parasite Research Branch, Agricultural Research Service, U.S.D.A., Beltsville, Maryland.

The embryonic (hexacanth) hooks of tapeworm oncospheres have received scant attention in cestode taxonomy, although these primitive, hard structures are more universally present in cestodes than hooks on the scolices. Kates and McIntosh (1950, J. Parasitol. **36** (Suppl.) : 45) suggested that "upon study of the embryonic hooks of a greater variety of species their morphology may prove indicative of phylogenetic relationships." It may also be possible to identify tapeworm larvae in intermediate hosts on the basis of the embryonic hooks retained thereon.

Embryonic hooks of a few species of cestodes have been accurately described in the literature. Those of about 2 dozen additional species have been studied. The observed variations in morphology and size are summarized as follows: (1) In some species all hooks are identical, in others there are 2 morphological types, and in others 3 morphological types. (2) They vary in length from about 7 to 25 or more microns. (3) some hooks are robust in appearance and others are slender. (4) Guards on hooks vary considerably in appearance and some hooks are without guards. (5) Handles of hooks may or may not terminate in a knob-like enlargement. (6) Other minor variations have also been detected.

Various techniques were tried for preparation of slides of tapeworm eggs for study of the minute embryonic hooks. The advantages of prior proteolytic digestion of gravid proglottids before slides are prepared, as well as the embryonic hooks of various cestodes, will be demonstrated.

98. **The Early Embryology of the Nematotaeniid Cestode,** *Baerietta diana* **(Hel[illegible]er, 1948)** *comb. nov.* L. T. DOUGLAS, Emory and Henry College, Emory, Virginia.

The entry of the spiral sperm nucleus into the primary oöcyte is followed quickly by the reappearance of oöcyte prophase chromosomes and, after this, maturation divisons. The polocytes are normally formed at the junction between the oöcyte and its attached yolk cell. Sometimes the forming polocyte displaces the yolk cell or even completely disconnects it from the oöcyte. Cleavage is alternate, unequal, and regular until the 6-cell stage is reached. The 6-cell embryo is composed of 2 macromeres, 2 mesomeres, and 2 micromeres, together with attached polar bodies and yolk cell. These are formed in the following sequence: 2 macromeres, micromere, mesomere, micromere, mesomere. (The 2 macromeres give rise to the remaining 4 blastomeres.) There are 3 embryonic membranes—one is chorionic and arises from uterine cells, and the other 2 are elaborated by specialized blastomeres.

99. **Early Stages of the Larvae** (*Cysticercus bovis*) **of** *Taenia saginata.* ALLEN MCINTOSH, Animal Disease and Parasite Research Branch, ARS, U.S.D.A. Research Center, Beltsville, Maryland.

The occurrence of cysticerci in the musculature of cattle in the Southwest has evoked requests for the approximate age of the larvae found at slaughter. The age of the cysticerci could be an indication as to when, where, and under what conditions the cattle became infected.

Most published accounts of the size and shape of cysticerci begin with those 4 weeks old. In the experimental infections reported here, observations were made at weekly intervals for the first 4 weeks and in one case at the end of 11 days.

At the end of the first week, when the bovine was slaughtered, there was no evidence of cysticerci. At the end of 11 days, small nodules, 2 by 3 mm, were noticeable to the naked eye, containing cysticerci 0.15–0.13 mm long by 0.13–0.09 mm wide. At the end of 2 weeks, cysts, 3 by 4 mm, were seen, containing thin, ovate cysticerci 0.16–0.17 mm long by 0.1–0.13 mm wide (animal condemned for cysticercosis). At the end of 3 weeks there were found: A cyst, 6 by 7 mm, from the heart, containing a balloon-shaped cysticercus 1.3 by 0.875 mm; a cyst, 8 by 9 mm, from the diaphragm, containing a bladderlike cysticercus 1.65 by 1.38 mm; and a cyst, 10 by 7 mm, from the masseter muscle, containing a saclike cysticercus 1.3 by 0.9 mm. At the end of 4 weeks, 3 cysts were found, 5 by 6, 4 by 8, and 5 by 7 mm, respectively, from the masseter, containing cysticerci 1.15 by 0.82, 0.95 by 0.95, and 1.1 by 1.18 mm, respectively. The cysticerci at end of 4 weeks showed invagination and the beginning of the development of the scolex; at this stage there was no evidence of suckers.

100. **A Survey of Cestodes in Mammals from Grand Canyon National Park.** F. J. KRUIDENIER AND V. GALLICCHIO, University of Illinois.

In total, 396 autopsies were performed during the course of the 1954 University of Illinois Museum collecting expedition to the Grand Canyon National Park, Coconimo County, Arizona. The host examinations included 43 species of mammals, representing 10 families of 3 orders. Cestodes representing 7 families of the order Cyclophyllidea were recovered from 14 species of mammals. They include: Catenotaeniidae (*Peromyscus maniculatus, P. truci, Perognathus intermedius, Spilogale gracilis* and *Thomomys bottae*); Mesocestoididae (*P. maniculatus, P. boylii, S. gracilis, S. putorius* and *Mephitis mephitis*); Davaineidae (*Sylvilagus audubonii*); Dilepididae (*Neotoma cinerea* and *P. maniculatus*); Anoplocephalidae (*Perognathus intermedius, Sylvilagus audubonii, Microtus longicaudus* and *Erethizon dorsatum*); Taeniidae (*Lynx rufus* and *P. eremicus*); and Hymenolepididae (*P. maniculatus*). Preliminary identification indicates that a minimum of 9 genera are recognizable.

A single new species of trematode of the family Brachylaimatidae was recovered from *Microtus longicaudus baileyi.*

101. **Nostril Entry as the Mode of Infection by the First Stage Larvae of a Rodent** *Cuterebra.* LAWRENCE R. PENNER AND FELIX P. POCIUS, University of Connecticut, Storrs.

Viable eggs from gravid *Cuterebra* females usually hatch in 5 to 9 days after laid, and first instar larvae readily enter the nostrils of exposed rodents. Larvae have also been observed to crawl from posterior placement on suckling rats to the nostril for entry. Single larval nostril entry has resulted in up to 80% successful infection and in most cases the furunculous cutaneous tumor with exposed grub soon appears in the groin. The average time in the host is 30 days although some grubs reach maturity and leave in 20. Mortality of infected young rats and mice is usually between 15 and 20%. The length of the pupal period for overwintering specimens is ordinarily between 6 and 7 months. Attempts to mate several pairs of adults from spring emergences have been unsuccessful and artificial insemination has not yet been attempted. Non-mated females lay infertile eggs in the vicinity of rodent feces. The largest number of eggs laid by a single gravid female was 1762, most of which hatched. Kittens, wild and domestic rabbits, guinea pigs, *Microtus pennsylvanicus, Peromyscus maniculatus,* and cotton rats were not successfully infected, whereas successful exposures were obtained in *Peromyscus leucopus* and in the roof rat, besides laboratory mice and rats. On a basis of our biological studies there is some question as to the true identity of the common species with which we are working. We are tentatively accepting identifications by other specialists that it is *Cuterebra fontinella* Clark.

102. **Studies on the Biological Control of Schistosome-bearing Snails: a Preliminary Report on Pathogenic Microorganisms Found in** *Australorbis glabratus.* C-T. PAN, Harvard School of Public Health. (Presented by demonstration as well as read)

(See Abstract #71)

103. **The Role of Documentation in Parasitological Research.** M. A. DOSS, USDA, Beltsville, Maryland. (Presented by demonstration as well as read)

(See Abstract #72)

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List of Meeting Places

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1926 Philadelphia
1927 Nashville
1928 New York
1929 Des Moines
1930 Cleveland
1931 New Orleans
1932 Atlantic City
1933 Boston
1934 Pittsburgh
1935 St. Louis
1936 Atlantic City
1937 Indianapolis
1938 Richmond
1939 Columbus
1940 Philadelphia
1941 Dallas
1942 New York (cancelled)
1943 (No meeting)
1944 Cleveland
1945 St. Louis
1946 Boston
1947 Chicago
1948 New Orleans
1949 New York
1950 Cleveland
1951 Chicago
1952 Ithaca
1953 Madison
1954 Memphis
1955 Atlanta
1956 Storrs

NOTICE

THE EIGHTH ANNUAL MIDWESTERN CONFERENCE OF PARASITOLOGISTS

The Conference was held at the State University of Iowa on June 11–12 under arrangements made by Dr. L. O. Nolf. Dr. W. D. Lindquist, Michigan State University presided. The meeting was dedicated to the memory of Dr. C. A. Herrick in recognition of his outstanding work in parasitology and his major role in the affairs of the Conference. Formal dedication was presented by Dr. J. E. Ackert, Dean Emeritus of Kansas State College after collaboration with Dr. A. C. Walton, Professor Emeritus of Knox College, Illinois.

A program was presented which consisted of 22 research demonstrations and a series of selected motion pictures dealing with various aspects of parasitology. After the annual banquet on June 11, Dr. William Headlee, University of Indiana Medical Center, discussed general phases of his work on the epidemiology of parasitic helminths in Thailand.

Dr. J. E. Ackert was elected Presiding Officer of the Conference for the coming year. The Conference is considering the feasibility of meeting at one of the midwestern summer biology stations in June, 1957.

Francis J. Kruidenier, Sec.-Treas.
Department of Zoology
University of Illinois
Urbana, Illinois

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